The American

GAS LIGHT JOURNAL.

(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

ILLUMINATION, HEATING, VENTILATION

AND

GENERAL SCIENCE.

VOLUME LVII.

(THIRTY-FOURTH YEAR)

FROM JULY 1 TO DECEMBER 31. 1892

A. M. CALLENDER & CO., Publishers,

OFFICE OF PUBLICATION, NO. 32 PINE STREET, NEW YORK CITY

LIBRARY OF CONGRESS
JUL 5 1892
SMITHSONIAN DEPOSIT

THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LVII.—No. 1. Whole No. 891. | NEW YORK, MONDAY, JULY 4, 1892. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order-registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C.O.D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

The Fair Fund 1

Briefly Told 2

An Extension of Time—The July "Outing" of The Gas Club of Chicago—Our Send-Out Inquiry—The Galena Gas Supply Partially Interrupted.

An Experience in Levelling-up Refractory Holder Tanks, by Mr. H. F. Allen 2

* Recent Researches on the Heat of Combustion of Coal 2

On Platinum Pyrometers, by Mr. H. L. Callender, M.A. 4

The Use of Oil for Carbureting Gas, by Prof. Vivian B. Lewes 6

Electric Companies Should Economize Waste Products 8

The Coal Resources of Missouri 8

Coal-Handling Plant 10

Ventilation 10

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 11

Manager Pearson's Ringing Letter on the Fair Fund—Mr. Thompson Chosen President, Ex-Post Boston—Mr. Sutherland is not a Stock Jobber—Mr. Vaughan Retires from the Houston (Tex.) Company—Betterments at Hudson, N. Y.—Contract for the Berlin Bridge Company—Gas Engines at Aberdeen, Scotland—Arc Lighting Prices, Canada—The Cincinnati Company is at the Dollar Rate—The Boston Gas Rate Hearing—Reported Sale of Control in the Milwaukee Company—The Hecla Compressed Gas Company—The Corn Cob Process to be Removed to Fairhaven—Cooking by Gas, at Lynn, Mass.—Ditto at North Adams, Mass.—Another Gas Rate Ordinance, Des Moines, Ia.—Cooking by Gas, Lawrence, Mass.—Davis & Farnum's Shops are on "Full Time"—And Many Other Items.

The Market for Gas Securities 12

THE FAIR FUND.

The progress made in rolling up the Fair Fund during the week was exactly nothing, which will make anything but pleasant reading for those who are anxiously and earnestly desirous of placing gas in its best estate before the throngs who, from all parts of the world, will visit the great show in Chicago in less than a year. This statement is all the more untimely because we have to make it in an issue bearing date of July 4, when the country commemorates its free, untrammeled independence. Perhaps it will come true in this instance, as we know it comes true once every 24 hours, that this is the hour before dawn. Practically, however, it is dispiriting to know that the evidence respecting the state of the Fair Fund all points to apathy, listlessness, indifference, and almost opposition on the part of many. There may be, in fact there is, some ground for the latter feeling, in that the Chicago Companies still maintain their ostrich-like attitude. With their heads snugly ensconced in the sands of the prairies, they seem to be comfortably oblivious to the peculiar showing made by the balance of their framework; and it looks that while they have thousands for tribute their treasury is bare of even cents for defence—for the proposed separate exhibition of gas at the Fair is founded on the plan that the showing shall be made to defend, and advance, gas interests and gas lighting against any and all other artificial lighting interests.

Our current item columns contain a common-sense and forceful letter from the Manager of the Consumers Gas Company, of Toronto, which puts the case in favor of the Fund in a light that is inextinguishable. Mr. Pearson's Company, which does business under another flag, found it a good proceeding to subscribe no less than $2,000 to the Fund, and the subscription was made in the avowed belief that the money was well and wisely invested. Mr. Pearson's faith in this matter may be said by some to be only a personal belief, and as such not entitled to any greater weight than an adverse opinion uttered or held by some one who believes that the game is not worth the candle; and that argument might have great force were it not for the fact that Mr. Pearson's Company has already tried the candle, and with the result that much game was bagged. It is true he was hunting in his own preserves, but the success was so great that he is willing to enlarge the area of the fields and cover that hold the game. Mr. Pearson's remark that "others may be holding back with the idea that there will be an exhibition anyway, and that they may as well get the benefit at the other (or subscribing companies') expense." Yes, Mr. Pearson; unfortunately the weight of evidence rather goes to show that that fraternal (!) course is being pursued to quite an important degree. There are some liberal people in the world, who are ardent admirers of the generosity of others, particularly when that generosity inures to the benefit of those who elect to play the admiration role. It is an easy one to play; but the part does not wear well—it is never billed through a long run. Nevertheless, we hope and confidently expect that the Gas Industry Council will eventually determine to go ahead with their project, basing the scope of the same on the amount of money that shall have been subscribed on a given date, even if the "admirers of generosity" do profit by that course out of all proportion to their deserts.

In the meantime it is well to remember that our foreign brethren are "all talking about us." Those in other lands have been so well schooled

to the fraternal spirit that so often accomplished so much that was seemingly impossible in America, that they have taken it for granted that the claim that the gas exhibit at Chicago would eclipse anything in that direction ever shown before was not a windy boast. The annual general meetings of the most important European Gas Associations were held last month; and, although Mr. Chas. Hunt (a name well known and universally respected in America), in his presidential message to the Incorporated Institution of Gas Engineers, did not allude to the proposed gas exhibit at the World's Fair, it is nevertheless well known that personally he is in hearty sympathy with the project. But Mr. Valon, in his inaugural address before the Incorporated Gas Institute, devoted considerable attention to the matter. President Valon informed his associates—having explained the scope of the proposed gas exhibition—that "Opportunity will be thus afforded to all professional visitors to become acquainted with the progress made in the industry up to date, covering work to be done in all parts of the world" * * * and concluded by remarking that he hoped "to meet a goodly representation from this Institute in Chicago next year." Again, M. Melon, President of the Society of French Gas Managers, at the Congress held in Tarbes, on June 7, referred to the proposed American exhibit in flattering terms. Great will be our fall, gentlemen, then, if we do not show, as an industry, in Chicago that we are doers rather than blowers; and the gas interest of Chicago, *per se*, will likely suffer most from the recoil.

BRIEFLY TOLD.

An Extension of Time.—As a respite sometimes is the forerunner of a pardon, we might be forgiven for hoping that an extension of time in which to complete the Fair gas building may be taken as an omen of eventual success. Whether so or not, we are in position to say that the Gas Industry Council have been informed by the World's Fair authorities that if the proposed building is completed by April 1st, 1893, the completion will have been made within the necessary time limit. We would, however, suggest that an extension of time does not in any sense mean that suspension of effort may be safely practiced.

The July "Outing" of the Gas Club of Chicago.—Secretary Fred. H. Shelton had a word or two to write us the other day about the Gas Club's doings. What he said was about like this:

"The regular May meeting was omitted by reason of the date conflicting with the Western meeting at Detroit. Rather than ask the Western to omit, or change, its date (!) the Club decided to go to the Western's wigwam in its customary noble style—being in this case, as you remember, a special car duly stocked with comestibles and combustibles, and, with ladies, friends and members to the number of 35 strong, affording a capital run to the city betwixt the Lakes. At the prospective date for the June meeting it was found that so many members would be absent from the city and others unable to attend for divers reasons, that the Managing Committee deemed it inexpedient to attempt to hold a meeting and so ordered. Special arrangements are now being made for the July meeting, which it is expected will be such a good one as to more than balance those omitted. I hope to send the announcement circular shortly."

Concerning these hints from the alert Shelton about the prospective July meeting of the Club, to say nothing as to private advices that we have which more than corroborate the evidence betwixt the lines of the Secretary's letter, it is probable that the famous April trip of the Club to Joliet will be outdone—and that outing is generally conceded to be the most enjoyable of the many enjoyable "times" that have been the Club's privilege. Mysterious hints of summer joys; a day off; steamer; Lakes; Cream City; Havanas—a la Garcia, with flavor increased by the strength of protection; gala time; jolly fellows—and so on—float our way sufficiently distinct to cause us to believe that "we'll take it in ourselves." That the customary enjoyment of the Club will be maintained cannot be questioned. Due notice of programme will be given in the Journal.

Our Send-Out Inquiry.—In a few days the managers of the gas companies selected by us to test the growth of the industry during the first half of 1892 will be mailed. We ask prompt attention to the inquiry, and those who intrust us with their returns may rely upon the faithfulness with which the figures will be guarded. They will be compiled by Mr. Thomas.

Among the sufferers by the recent disastrous floods in Illinois was Mr. J. B. Howard, at Galena. The Fevre river in overflowing its banks carried away the Green street bridge, along which passes the gas main that supplies the East Side. The actual money loss was $1,200, to say nothing of the inconvenience caused by the interruption of the gas service.

[A Paper read before the Society of Gas Lighting.]

An Experience in Levelling-up Refractory Holder Tanks.

By Mr. Henry F. Allen, of the Mutual Gas Light Company, New York City.

I have a matter to present to you at this meeting that I feel confident will interest you, and from it you may be able to gather a few ideas of how to treat with steel or iron tanks above ground that are out of level, or where a settlement of the foundation has taken place. It is an idea that to me was new, as it seemed to be to every one with whom I have talked about it; but as there is nothing new under the sun, I should not be at all surprised to hear that it was done some years ago.

Two years ago we took out the three old—Nos. 5, 6 and 7—holders on East 12th street. We filled the old brick tanks with ashes and cellar dirt. We left the water in the tanks so as to thoroughly puddle the filling material as it was dumped in, and we were careful to pick out everything of a perishable nature that we conveniently could. These old tanks leaked very badly; the bottoms were 9 feet below high water line in the East river, so that the tide rose and fell in one of them. After the tanks were filled in we drove a tube down in Nos. 5 and 6, and pumped out some of the water; we let them stand about 3 weeks, then put on 12 inches of concrete. We wanted to cone the foundation 12 inches in the center, but that was objected to by the parties who had the contract to build the tanks and holders. After the tanks and holders were finished, we filled them with water and put them in use—the tanks settled out of level, one of them as much as 3 inches. I watched them closely, trying the levels and taking soundings of the bottoms about once every 2 weeks, until they had apparently stopped settling. I emptied the water from one and put 18 cheaply constructed screw jacks, made of 2½ inch pipe, under the edge of the second sheet from the bottom, and easily levelled the tanks, shimming up as we went along. I then ran a grouting, of one of cement and two of sand, under the edge of the tank, put some old sheet iron around, leaving a space of 2 inches between it and the tank and filled the space in with sand, thus making a sand-seal; in the meantime, we had some 4 inch by 6 inch hand-holes cut in the bottom, made 6 boxes, shaped like an inverted pyramid, set them over these hand-holes, banked damp sand around them, put a 2 inch elbow in the bottom, with a ¾ inch steam pipe in it, filled the boxes with dry sand and turned the steam on. First, I raised the bottom of tank with an air blast, varying from 8 inch to 12 inch water pressure—the sand seemed to reach the remotest points under the bottom and pack in very hard. As they would fill up, we removed the boxes and put a small stream of water in through the openings, that seemed to level the sand in every place where it had banked up with the steam jet. We injected 300 cubic yards of sand "about" under each tank, rounding up the bottoms and making a solid, substantial job of it. We connected the old pipes in the tanks with a sort of a slip-lead joint, leaving out the new outlet pipes until we were sure that no more settlement would take place. This, or next summer, we will put in the new outlet pipes, and make further examination of the tanks.

I have been asked why we did not use broken stone or sand to fill the old tanks with, instead of ashes and cellar dirt. The reason was that we received 10 cents for every cubic yard of material that went in, whereas we would have had to pay from 60 cents to 90 cents per cubic yard for sand or stone. This would have cost us about $3,000 or $4,500 for each tank, whereas we received $500, and believed the ashes and cellar dirt would serve as well.

[Translated from the *Journal fur Gasbeleuchtung*, for the American Gas Light Journal, by Mr. Herman Poole.]

Recent Researches on the Heat of Combustion of Coal.

Formerly the heat of combustion of coal was determined by placing the fuel in a calorimeter and burning in a current of oxygen or air, as in ordinary combustion. Later, Berthelot perfected a method which depends on the enclosure of the substance to be burnt in a closed vessel, containing oxygen enough for the combustion. The vessel is called a "bomb," and the combustion is kindled by means of an electric spark. This method has the advantage that the combustion is very quick and complete, and hence the result attains great accuracy. A similar method of combustion, with simultaneous determination of the liberated heat, was used before by Th. Andrews for combustible gases, and described in *Poggendorf's Annalen*, volume 75, page 27.

Berthelot has used this method also on solid and liquid bodies, and brought it to a high state of perfection. So much so that, in the opinion of this reliable writer, it should be preferred to all others. In order to obtain a mixture containing the necessary amount of oxygen needed for

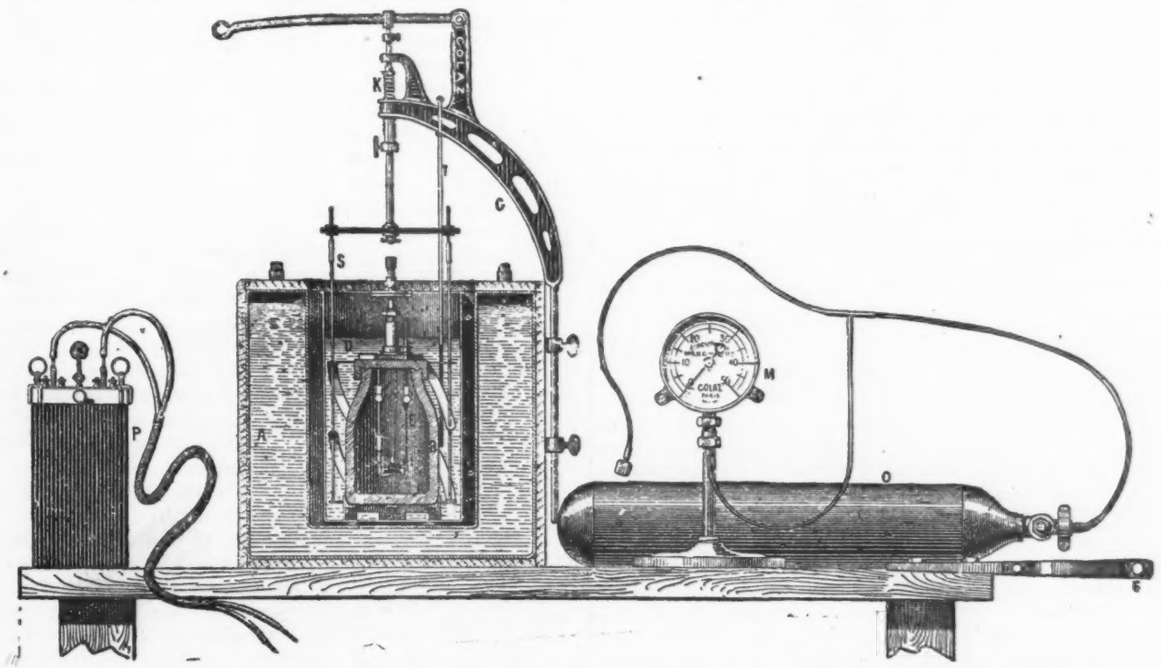
the combustion of the substance, the gas must be forced in and at a pressure of as much as 25 atmospheres.

For the compression of oxygen to 24 atmospheres, Berthelot and Stohmann use a compression pump, made by Golaz, a manufacturer of Paris.

The kindling of the substance to be burnt follows the ignition of a very fine iron wire, by means of a current from an electric battery. Stohmann used the so-called flower wire, 1 yard of which weighed 1.715 grains: at each experiment about 2 inches of wire, weighing 0.088 grain, were used. Since, according to Berthelot, 1 grain of iron gives off in burning 1,701 thermal units, there is a correction of 36.1 units necessary —a very small amount. For the combustion 15 grains of naphthaline can be used, or a like quantity of any other substance.

Since, in burning under pressure there is formed from the air itself *some* nitric acid, this quantity must be determined for the present research, and a corresponding correction made in the result. As the progress of the combustion is very rapid, and almost explosive, it is necessary, therefore, with finely pulverized substances, to form them into pastilles by partial fusion or compression.

Like the combustion chamber of other calorimeters, the "bomb" is placed in an enclosing vessel of water, arranged so as to prevent loss of heat, and the temperature of it measured. The maximum temperature



is reached in from 2 to 3 minutes. The advantages of the method are, briefly, as follows:

1.—Simplicity and rapidity of the process; at the same time, a very high degree of accuracy is possible.

2.—There are no unburnt secondary compounds formed (coke, carbonic oxide, etc.), the combustion being complete. Fifteen grains of naphthaline, or of a similar compound, can be completely burnt in such a "bomb." Sulphur is oxidized to sulphuric acid, and nitrogen to nitric acid, which dissolve in the collected water of combustion.

3.—A loss of free heat of the gases is prevented, since these remain behind in the apparatus. All the water formed condenses in the previously water-saturated air of the "bomb."

The calorimetric "bomb," as well as its use, is fully described by Stohmann in the *Journal fur Practische Chemie*, volume 39, page 507. During combustion in the calorimetric "bomb," there is not formed a warm mixture similar to that produced in a stream of oxygen under ordinary atmospheric pressure. All the combined oxygen condenses to water; after the combustion and cooling of the gases the pressure is found reduced. This necessitates a lower heat development than formerly, the allowance for a cubic foot being 400 thermal units, estimated at ordinary pressure of the air. In the combustion of gases, as carbonic oxide or illuminating gas, this may be considered, but with solid substances, as coal, a single calculation will show that no account need be taken of it. The carbonic acid formed from the carbonic oxide occupies the same space as the oxygen used, and is of no influence. Only the volume of the oxygen used in formation of water disappears. Four per cent. of available hydrogen, equal to .6 grain, condenses with about 15 cubic inches of oxygen and makes a correction of 23.8 units.

The formation of oxidation products from nitrogen and sulphur develops heat which can be allowed for in a similar way. For this purpose the acid mixture is titrated with normal alkali and needs a correction of 3.9 units for each grain of nitric acid. The separate determination of sulphuric acid is undertaken only in very accurate researches.

The high price of this calorimetric apparatus stands in the way of its more general use. This is mainly on account of the heavy platinum lining; this being from 2¼ to 3¼ pounds weight. The "bomb" used by Berthelot in his published researches was used before only by Scheurer-Kestner (*Comptes Rendus de l'Academie de Sciences*, 1891, vol. 112; *Annales de Chemie et Physique*, 1891, vol. 24, page 13; *Bulletin de la Societie Chemique de Paris*, 1891, vol. 5, page 941). The most valuable result is that Scheurer-Kestner trusts no longer his results obtained with the Favre-Silberman calorimeter—they are all too high.

Hempel, in his "Methods of Gas Analysis," has described an apparatus similar to the Berthelot "bomb."

Peter Mahler, a mining engineer of Paris (*Comptes Rendus, Bulletins de la Societe d'Encouragement*), has lately turned the Berthelot "bomb" to technical use, and has lowered its cost considerably, as he used in place of the platinum lining a coating of acid-proof enamel. His apparatus has served, so far, for 300 combustions, without the enamel lining being damaged.

The apparatus is shown in the accompanying cut. The calorimetric vessel is that known as Berthelot's. *A* is the outside vessel holding water, and surrounded by a thick layer of felt on the outside. The object of this is to absorb in the immediate outside of the calorimeter. *D* is the calorimeter vessel proper, holding 4.84 pounds of water. In this are the Berthelot spiral stirrer, *S*, and the "bomb," *B*. The parts, *G*, *K*, *L*, serve to impart in an easy way a reciprocal half-circular motion to the stirrer, and actuated by the hand. *S* is a thermometer with scale graduated to $\frac{1}{10}°$. The "bomb" itself is made of soft steel, having an elongation of 22 per cent., with a strain of 78,000 pounds per square inch. Its capacity is 38.9 cubic inches. The cover is screwed on and the joint caulked with lead. The Berthelot screw valve, which serves for the introduction of the oxygen, has undergone no modification. The substance is placed in the dish, *C*, in the interior of the "bomb." *F* is the end of an insulated platinum wire, leading through the cover, and fastened to the iron spiral for kindling the substance. *P* is the electric battery. In filling the apparatus a strong capillary drawn copper tube is screwed into the upper end of the screw valve, which leads to the pressure cylinder, containing about 60,000 cubic inches of oxygen, under 120 atmospheres pressure. Oxygen in cylinders can usually be purchased now. The manometer indicates the pressure. The "bomb" is filled with oxygen. A demonstration experiment, performed

by Mahler before the *Societe d'Encouragement* before mentioned, gave the following results: 15.4 grains of coal from Montrambert served for the combustion. The water value of the "bomb" and its accompanying apparatus was 16.9 ounces, and the weight of the water in the calorimeter was 4.84 pounds, or, together, 5.9 pounds. The temperature of the water rose 5.62°, the correction for loss of heat was 0.05°; the true temperature was, then, 5.67°. There was, therefore, 5.9 × 5.67 = 33.453 thermal units generated.

From this we deduct heat of combustion of the iron, .385 grain	.154
Heat of combination of 2.156 grains nitric acid	.127
Together	.281

After deducting these heats there remains the heat of combustion of 15.4 grains = 33.172; or heat of combustion of 1 pound = 15.086.

For the combustion of gases the "bomb" is emptied with a good Bunsen pump and the gas allowed to enter. This procedure is repeated to be sure that no residual air remains. Care must be taken, with generator gas especially, not to exceed the limit for explosive mixture, in adjusting the proportions. Some tests of illuminating gas of the Paris Company gave Mahler the following results:

	Heat of Combustion of 1 Cubic Foot 32° and 30 in. Thermal Units.	Specific Gravity Air Equals 1.	Heat of Combustion of 1 Pound Thermal Units.
City gas from La Villette (31 / × 91).	158.31	0.4033	19,338
Gas from Commentory Coal (3/ × 91)	164.25	0.404	20,000
Gas from Middric Cannel (30/ × 91).	180.13	0.6367	13,923

From the combustion of naphthaline we can check on the repeatedly calculated and directly determined water values; Mahler obtained:

First trial	37,429 units.
Second trial	37,469 "
Third trial	37,485 "

Berthelot gives a result agreeing well with these, or 37,472 units.

With the same apparatus Mahler burnt a large collection of coal samples at the meeting of the Society for the promotion of Industry, at Paris, the results of which have been hitherto published. We shall refer to these again, as there is a prospect of the publication of Mahler's researches in full.

We will also append a communication from Mahler on

"The Heat Balance Sheet in the Distillation of Coal."

At Villette, during the researches on Commentry coal, by the Paris Gas Company, all the various products of distillation made in the beginning of October, 1891, were collected and weighed. The calorimetric experiments gave the following results:

	Observed Heat Value per Pound Thermal Units.	100 pounds gave in Distillates.		Heat of Combustion Value of the Distillation Products.
Coal, originally	13,362	100.		1,336,200
Coke	12,635	65.66		829,629
Hydraulic tar	15,997	3.59	7.61	57,428
Tar from pipes	16,096	.87		14,003
Tar from condenser	15,896	1.16		18,438
Tar from scrubber	15,368	1.89		29,046
Gas dry	20,000	17.09		341,801
Ammonia water		9.36		
		99.62		1,290,345
Combustion heat of the coal				1,336,200
" " " " distillates				1,290,345
Loss by distillation				45,855

The products of the distillation preserve equalled 96.5 per cent. of the contained heat of the coal. We must acknowledge that the heat balance is very good, since no account is taken of the heat of the eliminated gases—sulphated hydrogen, ammonia, etc.; nor of any of the secondary products, as retort graphite.

On Platinum Pyrometers.

[A paper read by Mr. H. L. Callendar, M.A., before the Iron and Steel Institute, Great Britain.]

Many different kinds of pyrometers have been from time to time proposed, and have come more or less into use, for purposes of practical measurement. The great majority of these leave very much to be desired in point of efficiency and accuracy. I propose to confine my remarks mainly to two special kinds—the air pyrometer and the electrical resistance pyrometer—between which, I believe, the ultimate solution of the problem will be found to rest.

The great interest and importance of the air thermometer lies in the fact that it is the ultimate standard to which measurements of temperature must be referred. The laws regulating the expansion of gases are well known and understood, so that by measuring the increase of pressure or volume of a certain quantity of air inclosed in a suitable bulb of glass or porcelain, it is possible to calculate its temperature approximately on the true or absolute scale.

The theory of the air thermometer is extremely simple and perfect, but the practical difficulties in the way of constructing and using it are very considerable. This difficulty is well illustrated by a comparison of the results obtained by different observers. The boiling point of zinc, for instance, the temperature of which is only moderately high, has been determined with the air thermometer, with results varying between 1,080° and 900° C., a discrepancy of nearly 200° between the extreme values. If we take only the best and most careful experiments, the discordance is still considerable. Probably the most careful and accurate measurements yet made are those of Deville and Troost in 1880.* Using the same air thermometer in the same apparatus, under similar conditions, and employing the greatest precautions to secure accuracy, they obtained values varying between 954° and 929° C., a difference of 25° between the extremes.

The fundamental difficulty in the use of the air thermometer is the difficulty of procuring a material for the bulb which shall be rigid and air-tight at high temperatures. If, for instance, the bulb is made of platinum, the most infusible and unalterable metal that can be readily obtained in sufficient quantities, it is found to occlude or absorb a certain quantity of the air, which inevitably vitiates the results; and, further, it is shown to be very porous to several common furnace gases at a temperature of 1,000° C. Deville and Troost employed bulbs made of the hardest porcelain, glazed both inside and outside with felspar. This is a much more satisfactory material than platinum, but after a time the glaze inevitably cracks, and the air contained in the pores of the porcelain introduces an incalculable factor into the observations.

I have made many experiments myself with air pyrometers, both of platinum and porcelain, and have reluctantly come to the conclusion that really satisfactory results cannot be obtained with either of these materials. There is another material, however, with which I have experimented, of which I have greater hopes. The material I refer to is pure silica. It is an exceedingly refractory material, but at a sufficiently high temperature it fuses into a viscid liquid, which can be worked and blown like ordinary glass. It has, in addition to its infusibility, physical properties of toughness and hardness and elasticity, which make it in every way superior to glass or porcelain for scientific purposes. Unfortunately, owing to the high temperature at which it softens, it is very difficult to work, and requires considerable skill. I have only as yet succeeded in making very small tubes of this material. With further practice and larger apparatus I hope, however, to be able ultimately to make tubes and bulbs of dimensions suitable for air thermometer work. The material possesses all the requisite qualities, and I have no doubt that with its aid it will be possible to make really satisfactory instruments.

There is another difficulty in the way of the practical use of air pyrometers. The theory is delightfully simple. The pressure or the volume of the air in the bulb, whichever you prefer to measure, is simply proportional to the temperature measured on the absolute scale. But in actually measuring the pressure or the volume, there are several practical difficulties in the way of securing accuracy. 1. The air in the bulb must communicate with the measuring apparatus by means of a tube containing air. The expansion and contraction of this air in the connecting tubes must be estimated and allowed for. 2. The barometric pressure and the temperature of the surrounding air are constantly changing. These both enter as factors into the calculations, and have to be noted at each observation.

The result is that the calculations become somewhat formidable if any reasonable degree of accuracy is desired. For laboratory work this is not a serious objection, but it would be quite intolerable to the practical man. What he wants is an instrument which will indicate the temperature directly and continuously, without the trouble of calculation or constant adjustment.

Take, for instance, Wiborgh's air pyrometer, which has recently been described in the "Journal of the Iron and Steel Institute," 1888, No. II., page 110, and 1891, No. II., page 130, and is one of the neatest and most reliable of commercial pyrometers. At 1,000° C. the correction to be applied for the temperature of the surrounding air amounts to about 90° when the attached thermometer reads 20° C.; and a change of 1 inch in the height of the barometer involves a correction of about 50° C.

* *Comptes Rendus*, xc., p. 773.

These corrections cannot be neglected, and their application involves a certain amount of trouble and additional observation. Moreover, the instrument does not read continuously. At each observation of temperature it is necessary to force the mercury up to a certain level by means of a screw adjustment. In this instrument no account is taken of the air in the connecting tubes, which is necessarily a further source of error.

The maker has recently introduced an exceedingly pretty and ingenious aneroid modification. The corrections, as before, have to be made by special adjustment, and the instrument does not read continuously. The aneroid form is undoubtedly more handy than the other; but having regard to the well-known defects of the aneroid barometer and the imperfect elasticity of materials, I should not like to place much reliance on the constancy of volume of an elastic metallic box which was periodically squashed flat; and should feel very much disposed to doubt the maker's unqualified assurance that it is "perfectly accurate in its indications."

I have recently succeeded in devising a comparatively simple form of air pyrometer, which does all its own corrections automatically, and indicates the temperature continuously on an ordinary scale. This instrument is a modified and compensated form of the familiar differential air thermometer. A description of it has been published in the Proceedings of the Royal Society for December, 1891. It is compensated in such a way that its readings are not affected by changes in the temperature of the surrounding air, or by variations in the temperature of the connecting tubes. It is also completely sealed up, so that it is independent of the atmospheric pressure. With bulbs of hard glass it is possible to read up to 700° C., and the performance is all that could be desired at these temperatures. I have tried the instruments at higher temperatures with bulbs of platinum and porcelain, but, for the reasons previously given, their performance is then not so satisfactory. A bulb of fused silica would probably answer the purpose. Such a bulb, however, has still to be made.

To sum up, the great advantage of the air pyrometer is that it is possible to calculate the temperature approximately on the absolute scale. For theoretical work this is extremely important, and that is why I have devoted so much space to its consideration. For practical purposes, however, it is by no means essential, and the air pyrometer has several disadvantages. It is difficult, for several reasons, to make it read with sufficient delicacy and accuracy at high temperatures. It is necessarily fragile, unwieldly, and difficult to manipulate. There is always the trouble of making air-tight joints, and of finding a material for the bulb which remains sufficiently rigid and impervious at high temperatures.

The second form of pyrometer to which I referred, namely, the electrical resistance pyrometer, is, in my opinion, much better suited for practical work. It is much more sensitive and constant than the air thermometer, and also much easier to read and manipulate.

The action of the electrical resistance pyrometer depends on the measurement of the change of electrical resistance of a wire. Electrical resistance thermometers are generally made of platinum wire, owing to its infusibility and freedom from liability to chemical change. For this reason they are often called simply "platinum pyrometers," which is the name by which I shall generally refer to them in what follows.

Matthiessen showed many years ago that the resistance of a wire of almost any pure metal increased nearly in proportion to the absolute temperature. The resistance of a pure platinum wire increases by about 34 per cent. between 0° and 100° C. At 1,000° C. its resistance is about four times as great as at 0° C. Not only is the increase of resistance very large, but it can be very accurately measured. The measurement of resistance is much the most simple and exact of all electrical measurements, and there can be no doubt that thermometers constructed on this principle can be made much more sensitive and accurate than any other kind. They have a great advantage in this respect over thermo-couples. The electromotive force of a thermo-couple is by nature very small, and could not in any case be measured with the same ease and accuracy as a resistance.

The merit of having worked out the platinum pyrometer in a practical form, and of having introduced it into general use, undoubtedly belongs to Sir W. Siemens. In his Bakerian lecture in 1871 he explained the theory of the methods and described instruments capable of indicating temperatures up to 1,000° C.

The great convenience and advantage of the method were at once realized, and a committee of the British Association was appointed to test the instruments and report upon them. Their report, however, which was published in 1874, disclosed a most serious practical defect. The committee experimented chiefly with a pyrometer in an ordinary fire at moderate temperatures of about 800° C., and they found that the resistance of the pyrometer increased continuously with continued heating, and that the wire underwent rapid deterioration. They also made some experiment and suggestions with a view to remedy this defect, but they did not succeed in overcoming it. This continuous change of zero is certainly the most serious practical defect that a pyrometer can have, and there can be no doubt that the report of the British Association did a great deal to destroy confidence in this method of measuring temperature.

About 7 years ago, when I began making experiments on this subject at the Cavendish Laboratory, Cambridge, I was at first very much surprised to find that the platinum wires which I used did not undergo continuous change, even when subjected to much more severe tests than those applied to the Siemens pyrometer by the committee of the British Association. By making further experiments, however, with a sort of imitation Siemens pyrometer, I succeeded in reproducing at pleasure the effects they had observed, and in proving to my own satisfaction that these defects were not inherent in the method, but merely incidental to the particular form of instrument on which they experimented. I found that if the wire was properly protected from strain and from contamination, the pyrometers could be made practically free from change of zero, even at very high temperatures. Now, since I claim to have succeeded in constructing pyrometers on this principle which are free from this defect, I feel that it is incumbent on me, in order to restore confidence in the method, to explain the particular defects of construction of the Siemens pyrometer to which its changes of zero are due, and to show how they may be avoided.

The construction of the Siemens pyrometer has not, so far as I am aware, undergone any material change since 1874. The coil of platinum wire, which forms the sensitive part of the instrument, is wound on a clay cylinder, and packed in an iron tube from 5 feet to 8 feet long, and about an inch or so in diameter. I have here the fine wire and the clay cylinder from a pyrometer which was recently in use at the Royal Arsenal, Woolwich. I was informed that it had never been heated above 900° C., or 1,600° F., but its resistance had increased some 15 per cent., corresponding to an error of about 100° F., in the temperature measurements. When the instrument was taken to pieces, it was found that the wire was quite rotten and brittle in some places and sticking to the clay cylinder. This, I think, is sufficient evidence that the clay, or some impurity contained in it, attacks the wire, otherwise the local nature of the action could not be explained, unless the quality of the wire used was very inferior.

I have tried several materials on which to wind the wire, but have found nothing that answers so well as mica. The plan I generally adopt is to double the wire on itself and wind it round a very thin plate of mica, in such a way that it only touches the mica at the edges. This method gives very good insulation, even at high temperatures, and, so far as I can discover, the mica has no action on the wire even at temperatures, of 1,200° C.

Another defect of the Siemens pyrometer is the iron containing tube. Metallic vapors of any kind will attack the wire readily, and will ruin the pyrometer. It is not probable that the iron itself will be appreciably volatile at temperatures below 1,000° C., but it is very likely to contain several more volatile impurities. Vapors of copper, tin, zinc, etc., rapidly render the wire brittle and useless. A comparatively small trace suffices. Here, for instance, is a pyrometer with copper electrodes, which has been kept at a temperature of about 850° C. for an hour or so in a porcelain tube. The discoloration of the mica in the neighborhood of the copper leads shows that the copper was appreciably volatile at this temperature, 150° C. below its melting point. The resistance of the platinum coil was in this case increased by nearly ½ per cent., owing to the action of the copper. For this reason copper or silver leads cannot be used in pyrometers for high temperature work.

The pyrometer which I have handed round has silver leads, and is intended for working up to temperatures of 700° or 750° C. only. It is inclosed in a tube of very hard glass, which does not begin to soften till nearly 830° C., that is to say, at a bright red heat.

For work at high temperatures it is essential to use leads of platinum, which must be fused, not soldered, on to the fine wire of the coil. Solder of any kind is quite inadmissible, and screw contacts, such as are used in the Siemens pyrometers, are clumsy and liable to change their resistance with repeated heating.

Glass cannot, of course, be used for the containing tube in high temperature work. In my experience a hard glazed porcelain tube does very well to protect the wire, at least up to temperatures of 1,200° C. A silica tube would probably do even better, but I have not yet succeeded in constructing such tubes the requisite size.

The instruments which I have here are inclosed in porcelain tubes. Their interior construction is precisely similar to that of the pyrometer which I have handed round, except that they have platinum leads. This particular pattern is intended for laboratory work, and for testing small samples; but you will understand that they can readily be made of any other pattern to suit furnace work. For some kinds of rough work it is convenient to protect the porcelain or glass tube with an outer tube of iron, and to make the instrument much larger.

It has been objected that the necessity of inclosing these pyrometers in a porcelain tube is a serious drawback, on account of the size, expense, and fragility of the tubes. I would first observe that, whatever kind of pyrometer is used, it is necessary to protect the sensitive portion in some way, if results of any accuracy are desired. Even with a thermo-couple the wires must be insulated, and must be protected from contamination, or it is necessary to cut off the junction and graduate the instrument afresh. Secondly, I would observe that porcelain has hitherto been found to be the most suitable material for high temperature work, and that good porcelain tubes are not so fragile as is commonly supposed. I have only as yet had the misfortune to break 1 tube, and that was with a hammer. The pyrometer in question had been in use for about 6 months. The exterior of the tube had been attacked by lead oxide, alumina, cast iron, and other powerful reagents, and had been very roughly treated in scraping off adherent masses of metal and slag. At the close of some experiments at the Mint with Professor Roberts-Austen the pyrometer suddenly refused to indicate. We supposed that some metal must have found its way through the tube, and a post mortem examination was accordingly performed with a hammer. To my great annoyance I found that there was nothing the matter with either the tube or the pyrometer, and that the defect was simply due to a short circuit of the external leading wires, caused by the softening of the gutta-percha insulation. Since then I have taken the precaution of insulating the leading wires with silk or asbestos, and have not had the misfortune to break any more tubes.

[To be concluded.]

[A paper read by Prof. Vivian B. Lewes, F. I. C., etc., before the Incorporated Institution of Gas Engineers.]

The Use of Oil For Carbureting Gas.

During the past few years the gas managers of this country have gradually been accustoming their minds to the search for promising sources of enrichment for coal gas, in order to prepare for the not far-distant day when cannel will have to be replaced by some other carbureter.

First and foremost amongst the materials likely to be utilized for this purpose, stand the various grades of oils popularly known as petroleum and paraffin; and the object of this paper is to bring before you the results of a long series of experiments made with the view of ascertaining how far we may rely upon oil as a means of enrichment for coal gas of poor illuminating power.

The main points which it is important the gas manager should have in view, in forming a judgment upon the probable future of oil as a carbureting material, are—

I. The grades of oil from which to obtain the best results.
II. The methods by which the greatest illuminating value can be obtained from various oils.
III. The relation between the cost of the various grades of oil and the results which can be obtained from them.

In attempting to solve questions of this description, it is important that, if the results are to be of any value for the purpose of comparison, the determinations should all be made under as nearly as possible the same conditions and by the same observer; and that the greatest attention should be paid to the determination of illuminating value.

My own views on the subject of photometry are that, before any accurate determination can be made, the rate of flow and size of burner used must be fixed to suit the physical peculiarities of the gas to be tested. With a gas of under 18-candle power, and with a specific gravity of about that of ordinary coal gas, the standard Argand gives the best test results; whilst, as is well known, with illuminating values above 25-candle power, a flat-flame burner must be used—the size of the burner decreasing as the gravity and illuminating value of the gas increase.

In the following experiments, the "London" Argand has been used as the burner for all gases from 9 to 18-candle power; the flame being kept 3 inches in height. From 18 to 25-candle power, both Argand and flat-flame burners were employed. Above 25-candle power, selected Bray burners were used; the flow of gas and size of burner being regulated to give the best obtainable flame, and the rate of flow being accurately noted, the results were calculated to 5 cubic feet per hour. In all cases standard sperm candles were used; and the determinations were made in an Evans-Sugg photometer, with all the usual precautions and corrections. All candle powers given are the mean of three sets of ten readings. The first experiments were to determine the relative values of oils which could be obtained in such quantities, and at such prices, as would render them commercially possible to use for the production of oil gas; and also to find the most favorable temperature of "cracking," to yield the highest results. The retort employed was of iron, 1 foot 10 inches long, and 4 inches in diameter; the tube by which the oil was fed in, passing from the front to within an inch of the back of the retort; whilst to keep the temperature as nearly as possible the same throughout, the retort was loosely packed with coarse iron turnings.

The oils employed were:

I. Russian "distillate" oil, having a specific gravity of .864, and a flashing-point—open, 149° F.; closed, 135° F. This is the same oil as that employed on a large scale at Beckton for carbureting the water gas made by the improved Lowe process.
II. Crude Russian oil, having a specific gravity of .866, and a flashing-point—closed, 55° F.; open, 59° F.
III. Intermediate shale oil, having a specific gravity of .868, and flashing-points above 250° F.
IV. Green oil of a specific gravity of .848, and a flashing-point over 150° F.
V. Blast-furnace oils of a specific gravity of .848, and a flashing-point of 221° F.

I. *Russian Distillate Oil.*

Temperature of Cracking.	Yield of Gas per Gallon C. F.	Percentage of Residuals.	Candle Power per 5 Cubic Feet.	Candles per Gallon of Oil.	Grains of Sperm per Gallon of Oil.
Incipient red *..	12	59.1	54.8	131.52	15,782.4
Medium red †...	60	22.7	50.7	608.40	73,008.0
Full red ‡.....	84	11.8	42.2	708.96	85,075.2

II. *Crude Russian Oil.*

Incipient red *..	20	44.3	6.6	226.50	27,180.0
Medium red †...	56	17.6	48.4	542.08	65,049.6
Full red ‡.....	80	8.8	47.2	755.20	88,624.0

III. *Intermediate Shale Oil.*

Incipient red *..	8	81.8	44.8	71.88	8,625.6
Medium red †...	48	20.9	56.1	538.56	64,627.2
Full red ‡.....	80	15.4	42.0	672.00	80,640.0

IV. *Green Oil.*

Incipient red *..	16	18.1	61.1	195.20	23,424.0
Medium red †...	48	22.6	59.2	568.32	68,198.4
Full red ‡.....	70	33.3	50.1	701.40	84,168.0

V. *Blast-Furnace Oil.*

Incipient red *..	12	72.7	40.2	96.48	11,577.6
Medium red †...	56	54.1	25.6	286.72	34,406.4
Full red ‡.....	68	36.3	22.9	316.44	37,972.8

* 977° F. † 1,292° F. ‡ 1,652° F.

These results, having been obtained under exactly similar conditions, may be taken as being strictly comparative; although they do not represent the highest possible results obtainable. They show that the Russian oils are the best for carbureting; and that a full red is by far the best temperature at which to crack them. Other experiments show that, if the temperature of cracking is pushed beyond this point, the increase in yield of gas is considerable; but the fall in illuminating value is so rapid that no advantage is gained. Next to the Russian oils, and but little inferior to them, come the intermediate and green oils; whilst for for cracking in this way, the blast-furnace oils are practically useless.

We have now to consider how oil can best be converted into a permanent gas, so as to yield the highest possible illuminating value per gallon of oil used; as it by no means follows that the simple retorting of the oil is the best method to employ.

The first step in this direction was to try and ascertain if cracking the oils in contact with a large surface of carbonaceous material in any way tended to increase the illuminating value of the gas; as it was quite conceivable that the surface action of a mass of red-hot coke or charcoal might influence the chemical changes taking place during the conversion of the oil into a permanent gas.

In order to do this, two tube retorts four feet six inches long and two inches in diameter, with an oil tube passing down the center and deliv-

ering at the closed end, were arranged side by side in the same furnace, so as to ensure equal heating. One of these retorts was packed with small pieces of coke, the size of big peas; while the other was left empty—the gas from each retort being led separately through a depositing tube and washer to a gasholder, where it was collected, and afterwards tested. In all cases the temperature employed was a bright red heat.

The first thing that strikes one in these results is that the use of a long narrow retort has caused a distinct improvement in the quantity, and also illuminating value, of the gas, as compared with that obtained by using a short broad retort; and it has brought into striking prominence the superiority of the two Russian oils over the shale oils for gas making purposes. The experiments also show that the presence of the carbonaceous surface during cracking, although it slightly increases the luminosity, does so to so small an extent that it would be hardly worth while to incur the extra risk of choking in the apparatus by using it.

Oil Used.	Without Carbon.		With Carbon.	
	Cub. Ft. of Gas per Gal.	Illum. Power.	Cub. Ft. of Gas per Gal.	Illum. Power.
"Distillate" oil.....	92	46.00	92	47.13
Intermediate shale oil..	60	52.00	56	55.20
Green oil.....	68	59.00	64	58.80
Crude Russian oil.....	92	50.10	92	52.30
Blast-furnace oil.....	52	28.40	52	34.30

In the case of the blast furnace oils, the increase is much more marked—amounting to no less than 20 per cent., which is due to the fact that these oils contain a certain quantity of phenol, which is converted into benzene by passage over the red-hot carbon.

So far, the experiments have shown that, amongst the oils the price of which renders them available for gasifying, the Russian oils are the best; and we have also seen that very little is to be gained with these oils by using carbon in the chamber in which the cracking takes place, whilst a long narrow retort gives better results than a short broad one.

The next point to determine is whether the illuminating value of the oil gas can be still further increased; in other words, if a higher illuminating value per gallon of oil can be obtained by any other process.

The petroleum oils are all mixtures of highly complex hydrocarbons, which are liquid at ordinary temperatures; and on retorting these oils, the heat first volatilizes them, and then casuses a breaking down of their molecules, with the result that simpler hydrocarbons, gaseous at ordinary temperatures, are formed, whilst liquid hydrocarbons, of far lower boiling point than any existing in the original oil, are to be found in the tarry residue. Of the gaseous hydrocarbons so obtained, some belong to the saturated or paraffin group; and the higher members—such as ethane, butane, propane, etc.—have a high illuminating value; while still more valuable in this respect are the unsaturated hydrocarbons, of which ethylene, benzene, toluene, and crotonylene are the most abundant in the gas. These hydrocarbons have all been formed from more complex ones by the action of heat; and after their formation, an increase of temperature continues the breaking-down action, and gives rise to marsh gas, which is of little illuminating value, and finally of carbon and hydrogen—the former being deposited, while the latter has no light-giving power,

The range of temperature within which the oil can be decomposed so as to give the largest possible volume of the hydrocarbons valuable for illumination is very narrow; and the wall of a retort is always far hotter than the gas near the center of the retort. The result of this is that from the central portion some of the oil vapors escape "uncracked," and deposit from the gas on cooling; while the vapor in contact with the wall of the retort gets overheated, deposits coke and pitchy matter, which tends to choke the exit pipes, and yields a certain proportion of gas of low illuminating value, so that with the ordinary forms of oil gas retorts the full illuminating value obtainable from the oil is never reached.

This loss might to a great extent be overcome on a small scale by altering the form of retorts, and by a very careful regulation of the temperature, but on a larger scale this would not be possible.

On a manufacturing scale better results may be obtained by "cracking" the oil vapors in an inert gas, such as hydrogen, carbon monoxide, or water gas, which by separating and partly protecting the molecules during their decomposition by heat, increase the range of temperature within which the best results can be obtained, and prevent excessive breaking down of the hydrocarbons and consequent loss of illuminating value. That this is the case is shown by the following experiment: A known volume of coal gas was taken and passed through a porcelain tube packed with broken pieces of the same material, and heated to bright redness. A copious deposition of carbon was the result; and the gas after cooling burnt with an almost non-luminous flame. The same volume of coal gas was now diluted with twice its volume of hydrogen, and was passed at the same rate of flow as before through the tube heated to the same temperature, and only 1-200th of the amount of carbon previously thrown down was deposited.

Ample verification of this interesting and important fact can be obtained from the data collected in carbureting water gas by several of the best known systems in which the oil vapors are carried by the hot water gas through heated chambers, in which the decomposition of the oil to permanent gases is effected, and yields results which could not be approached by making the oil gas and water gas separately and afterwards mixing the two.

Take, for instance, the Russian "distillate" oil. The best results obtained by cracking it by itself were 92 cubic feet of 46-candle power gas per gallon, which is equal to 846.4 candles per gallon; whilst the same oil, when cracked in a current of water gas in the improved Lowe apparatus at Beckton, yields (according to the figures given by Mr. Goulden in his paper read before this Institution in May last) no less than 1,200 candles per gallon, or an increase of nearly 42 per cent.

The working from which Mr. Goulden quotes these results, however, was on a very large scale, and under the best conditions; and in order to obtain a comparative result, it was necessary to contrast the results obtained by cracking the oil alone, and also in the presence of an inert gas, under precisely similar conditions.

For this purpose, oil was cracked alone in a short experimental retort and collected; whilst after a time, the rate of flow of oil and temperature being kept constant, a slow current of hydrogen was allowed to flow, in known quantity, through the retort, and the resulting mixture of gases collected in a separate gasholder.

The results so obtained were—

Distillate oil cracked alone yielded per gallon 84 cubic feet of 42.2-candle power gas = 709 candles;

Distillate oil cracked in an atmospere of inert gas yielded 92 cubic feet of 53.8-candle power gas = 989.9 candles;

or an increase of over 27 per cent.

The results quoted in this paper were all obtained with the view of getting strictly comparative figures; and they must not be taken as representing the highest obtainable results. Working on a large scale with the Russian distillate and intermediate oils, 76 to 80 cubic feet of 50 to 60 candle power gas was about the usual result; and this may be accepted as the normal yield, more especially as the figures obtained in continuous working under the best systems in use confirm them.

We have now to consider the question of cost, in order to form an opinion as to whether a poor coal gas can be economically enriched by ordinary oil gas.

With regard to the cost of the oils experimented with, the Russian oils can be delivered in bulk at almost any English port at 3d. to 3½d. per gallon; whilst the intermediate and green oils can at present be bought in the neighborhood of Glasgow at 3½d. to 3¾d. per gallon. The cost, therefore, of oil as an enricher will vary according to the distance of the works from the nearest sea port, and the facilities for carriage.

Taking the price of the Russian "distillate" oil at 4d., which would be the cost at the majority of works, we can calculate the cost of the gas from the following data: Using three retorts, 25 gallons of oil yielded 2,300 cubic feet of 55-candle power gas* in 7½ hours, with an expenditure of 7 cwt. of fuel; but the man who attended to the retorts could equally well have taken charge of twenty instead of three.

	s.	d.
25 gallons of oil, at 4d.....	8	4
Fuel.....	2	6
Labor.....	1	2
Charge on plant, etc.....	0	1
	12	1

or 5s. 3d. per 1,000 cubic feet of 55-candle power gas.

Taking this in candle units, the cost of the oil gas is 1.21d. per candle; but it would more often work out to five farthings. We can now compare these results with the figures obtained by Mr. A. G. Glasgow with the same oil at Beckton, in the improved Lowe water gas plant, which are 1s. 6d. per 1,000 feet for 24-candle power gas, or at the rate of 0.75d. per candle unit.

These experiments and figures seem to clearly show that no method of retorting oil alone, even under the best conditions, can compete with processes such as most of those in use at the present time in America, in which the oil is cracked in an inert gas, at the expense of the waste

* A very high result.

heat from the water gas generator. We can now, therefore, answer the questions with which this paper was commenced, as follows:

I. Russian petroleum is the oil best adapted for carbureting.

II. The best results are obtained by decomposing it in the presence of an inert combustible diluent.

III. The cost of carbureting by such material would be ¼d. per candle unit.

Electric Companies should Economize Waste Products.

Mr. I. H. Babcock, writing in the *Western Electrician* on this subject, says that every city and every village of any pretention has its water supply for domestic and fire purposes. Systems of lighting by gas or electricity from a common center supply another necessity of our modern life. Why should the district system, now so universal and so popular, stop with water and gas? Heat in the northern latitudes for our buildings during eight months of the year is as much of a necessity as is water or light.

Some 14 years ago Birdsill Holly, of Lockport, N. Y., conceived the idea of conveying steam underground in wrought iron pipes, for distribution to dwellings, stores, offices, churches and public buildings, in the same way that water and gas are supplied. The steam was to be economically made in large boilers at a central station, and a continuous supply furnished from the beginning to the end of the heating season.

Since the initial system was built and operated by the American District Steam Company at Lockport, N. Y., in 1878, there has never been any real question as to the feasibility of the enterprise. In constructing pipe lines for steam some conditions had to be met which do not exist in lines laid for water or gas. The pipes must have reasonably cheap protection to prevent undue radiation; and the contraction and expansion of the iron must also be provided for to prevent buckling and breaking the pipes.

The first desideratum was provided by the use of wood logs, bored to receive the iron, with an air space between the iron and the wood. The iron is thus defended from contact with the moist earth, and the wood under these conditions is found to be almost indestructible. Contraction and expansion are provided for by the patent service "variator," which is placed at proper intervals, and connected with the ends of sections of iron pipe. Service pipes are taken off from the main line at points opposite the buildings to be heated. In each building there is a regulator to reduce the steam pressure for house use, and a meter tells each consumer how much steam he has consumed. The steam is on tap constantly, and the consumer may use it by simply opening his radiator valves.

Some 40 or 50 of such systems have been constructed and are now in operation in various parts of the country. This method of supplying heat is popular wherever it is in use, for the reason that the taker of district steam is spared labor and care, risk of fires in the building and the dust and annoyance incidental to the handling of coal and ashes. The absence of gas from an individual heating apparatus, which usually vitiates the air, and the constantly uniform temperature of rooms heated from a central source of supply, are found to greatly promote the health and comfort of the family.

Within the last few years a new phase of district steam heating has presented itself, in connection with the large number of steam power plants which have sprung up in nearly all our cities. With advancing civilization electricity has become a potent factor in the events which make up the history of our everyday life. That subtle fluid not only lights our buildings and our streets, but carries the motive power which propels lines of street cars and other machinery for industrial uses both great and small. The sudden rise of this industry has led to the rapid construction of great power stations, in some cases thousands of horse power being generated under a single roof. In the engine work of these stations it is well known that only about 10 per cent. of the heat units of the steam is converted into energy, and nearly $\frac{9}{10}$ is still available for the heating of private and public buildings. Where the station is located, as most of them are, contiguous to business houses or resident sections, underground lines of pipe can be laid and connected with the exhaust pipes of the engines, and made use of to distribute this steam wherever it may be wanted in the district.

Some electrical companies are already deriving a large revenue from this otherwise waste material, and many others are preparing to profit by the application of this method.

Electrical work follows the rule which applies in all other successful enterprises. Close business management and the utilizing of all the forces at command are necessary to financial success, and without financial success the prosecution of no enterprise can be permanently continued. When the business of the electrical companies becomes as well systematized as is the manufacture and sale of gas, there will no longer be a question as to its success financially. The gas producing industry is not going to be driven to the wall by this new comer; each system will occupy its allotted field, but there will be a wholesome rivalry, in which the new candidate will be obliged to adopt some of the business methods of its older adversary.

The authorities of Cleveland, O., not long ago demanded of the gas company a lower price for the gas supplied. In the investigation in court which followed, Engineer Hyde testified that it actually cost his company 48 cents per 1,000 feet to put gas in the holder, but that residuals are worth 27 to 30 cents per 1,000 feet of gas manufactured, showing that the first cost of gas was reduced 60 per cent. in the sale of bye-products. The cost of distribution Mr. Hyde placed at 30 to 34 cents per 1,000 feet, making the total first cost of production and distribution about 82 cents per 1,000 feet. Deducting the value of residuals, the net cost to the company was shown not to exceed 55 cents per 1,000 feet, or a saving of nearly 35 per cent. by the sale of waste products.

This data I introduce here to show the methods in use in a long established business, with the idea of enforcing the application of similar methods in the affairs of electric companies.

Every 100-horse power of steam used for engine work will heat, after passing the engine, 1,000,000 cubic feet of space in buildings. This exhaust steam is a residual in the same sense as the so called residuals which the gas companies turn into money. In one case these are made to pay dividends, while in the other they are too frequently thrown away. In view of the facts as stated, would it not be wise for many of the electrical companies to imitate the methods and business policy of their older and longer established rivals?

The Coal Resources of Missouri.

The following interesting matter respecting the production, markets, tonnage and duration of supply, and the value of the coal and coal lands of Missouri, is taken from the preliminary report of the Geological Survey of that State:

The total production of coal in Missouri for the year ending June 30, 1891, was 2,650,028 tons, valued at $3,480,867. According to Bulletin No. 10 of the Eleventh Census, Missouri ranks second as a coal producer among the States west of the Mississippi river, Iowa being first with a production of a little over four million tons. Colorado is ranked next after Missouri, her production being 2,544,144 tons, and Kansas is fourth with a production of about 2,200,000 tons per annum. After these no other of the Western States approaches Missouri in the amount of coal produced. According to the same Bulletin, Missouri ranks ninth as a coal producer among the States of the Union, Pennsylvania leading off with the magnificent figure of over 80,000,000 tons, Illinois being next with about 12,000,000 tons, Ohio third with nearly 10,000,000 tons, West Virginia next with over 6,000,000 tons, and then Iowa, Alabama, Maryland, and Indiana preceding Missouri in the order given.

The amount of coal produced in the State is, thus, both absolutely and relatively, large. Its value is greater than that of any one other mineral product in the raw state, the production of lead for the year ending June 30, 1891, according to the State Mine Inspector's figures, being valued at $2,411,399, that of zinc at $2,673,073, and of iron at $331,665.

According to the list of coal mine operators appended to this report there are, in all, 385 individuals and corporations engaged in mining coal. Of these, one organization mines *about a fourth* of the total amount produced each year; 10 companies mine together nearly two-thirds of the total amount, and 60 individuals and companies mine together about five sixths of the total, leaving for 315 individuals and companies the production of one-sixth.

The principal coal producers, in the order of the amounts of their products, are: The Rich Hill Coal and Mining Company, the Western Coal and Mining Company, and the Lexington Coal and Mining Company, these three being under one management, with mines in Bates and Lafayette counties; the Kansas and Texas Coal Company, with mines in Macon, Ray, and Linn counties; the Keith and Perry Coal Company, with mines in Henry and Bates counties; the Richmond Coal Company, with mines in Ray county; Loomis & Snively, with mines in Macon county; the Mendota Coal Company, with mines in Putnam county; the Inter-State Coal and Mining Company, with mines in Randolph county, and the Randolph Coal Company, with mines in Randolph County.

The conditions affecting the market of the coals west of the Mississippi River are, in some respects, different from those in the eastern

part of the country. The Western bituminous coal field is surrounded on all sides by large expanses of country destitute of merchantable coal.* These great areas with their constantly increasing population and needs, must, under natural conditions, draw their supplies of coal largely from the mines of Iowa, Missouri, Kansas, Arkansas, Indian Territory and Texas. The area of workable coal is also restricted in Kansas, Arkansas, Indian Territory and Texas, only a small portion of the coal measure areas there being productive. East of these areas their coals are brought into competition with the coals of Illinois, Indiana, Kentucky, and Ohio in the North, and with those of Tennessee and Alabama in the South; even the anthracites of eastern Pennsylvania are sold within the very limits of these western coal fields, on account of their special adaptabilities. The natural facilities for transportation provided by the Ohio and Mississippi rivers enable the coals of western Pennsylvania and of Ohio to compete very successfully with the geographically much nearer western coals, especially along the lower Mississippi. Further, through the distribution of railway lines and adjustments of rates, Illinois coals force the competition line much farther west than would seem possible from geographic considerations. Thus the territory affected by this competition to the east is large, and it will probably always be considerable, though subject to variations.

Towards the west, however, there stretches a great area of country in Nebraska, Kansas, Indian Territory and Texas, which is not only destitute of coal, but which has, further, a sparse supply of timber to answer as a substitute for such mineral fuel. This is especially the case in Kansas, and its effect upon the Missouri coal industry is important. West of this coal-barren area are the deposits of Dakota, Wyoming, Colorado and New Mexico, which are to a certain extent competitors in the market and which may become more so in the future. It is not to be anticipated, however, that this competition with the coals of Missouri and adjacent States will reach very far east, for the latter coals are generally superior in quality to those farther west, which are largely lignitic, and the supply of superior coals in Colorado and New Mexico appears to be no more than is needed to satisfy the home needs and the more imperative demands for coal still farther west.

Thus the coal-barren area surrounding the Western bituminous coal fields may be looked upon as a most promising market for the future, especially that to the West where the population is destined to increase rapidly in the next few years, with a proportionate increase in coal consumption.

In addition to the foreign market, however, there is in Missouri a good home market; one which is destined to increase greatly in the future, and which will always be a steady consumer of coal and the most substantial supporter of the coal industry. The coal fields of Missouri are not located in a mountainous, rugged, or sterile country; on the contrary they are in a country of moderate elevation, with gentle undulating surface, where bluffs and steep declivities occur only along the largest streams; a country with a most fertile soil in a well advanced stage of cultivation. It is already well populated, a network of railways traverses it, small towns are numerous, and cities occur at short intervals. These conditions furnish consumers for the coal at the very mouth of the mine; they cause small operations to be numerous and to be profitably prosecuted, and they further permit the mining of coal for local uses under conditions which would not be profitable for the general market. In addition, these conditions furnish opportunities for obtaining labor, and inducements for retaining it, which are entirely absent in many coal mining regions.

The railways of the State constitute, without doubt, the largest class of consumers of coal. Hence the greatest single use to which coal is put is for the production of steam in locomotives; but, for manufacturing purposes, a large amount of coal is also used in steam production. Domestic consumption in stoves and furnaces ranks next in importance. For the production of illuminating gas a few coals of the State have been roughly experimented with, but not with general satisfactory results, and very little of the coal product is used for this purpose. Thus coal from the vicinity of Moberly has been used there at the gas works, and, when well purified, the gas from it was excellent, but the cost of purifying it from sulphur was too great. The coal mined at the Hamilton Coal Company's shaft in Caldwell county has been tested for gas production and is reported to have yielded an abundance of gas, but it would not coke in the retorts, and, therefore, could not be profitably used. The coal mined at Trenton, in Grundy county, has also been tested with similar results. In Henry county are several coals which have been used for gas production, with reported favorable results. The thick coal bed south of Lewis station is such a coal, and also that from the Pitcher mine south of Clinton. These coals have been used, not only in the immediate vicinity of the mines, but have been shipped to remote points in the State for this special purpose. The coal mined at Minden, Barton county, also gives promise of being a gas producer, inasmuch as coal from the same bed mined at Cherokee and other points farther west in Kansas, is largely used for that purpose.

No coal in the State, to the writer's knowledge, is used for coke manufacture. Partial tests have been made of a few coals, but the results were not encouraging. The coal from the Excelsior Coal and Coke Company's shaft, at Higginsville, in Lafayette county, was thus experimented with. The product was of fair quality for domestic use, but was too weak and contained too much sulphur for furnace use.

Concerning the adaptabilities of Missouri coals we know, therefore, little even in a general way, and practically nothing in a detailed and authoritative way. As steam producers we know that they are extentensively used, but what their relative evaporative powers are as compared with each other we can say nothing at present; and we are equally in the dark as to how they compare, in this respect, with the coals of other States with which they are brought into competition. We know that the same coal burnt in different furnaces will yield very different results, and *vice versa*, that the same furnace fired with different coals produces different amounts of steam; yet we are unable to say of the various Missouri coals in just what furnaces the best results may be attained with each. We know that some coals are better for steaming purposes, some for domestic purposes than are others; but which are the best domestic and which the best steaming coals of Missouri we cannot say.

Gas coals and coke are imported into this State from Pennsylvania and are sold here at necessarily high prices. It is by no means improbable that there exist coals in the State which could be used more economically for the purposes for which these coals are imported. It is, therefore, in the interest of both the owners of coal lands and the producers of coal, as well as of the consumers, that the adaptabilities of the Missouri coals be first definitely established and then that the various coals be applied to those uses for which they are best suited.

Estimates have been made in publications of past years of the probable amount of coal in the State. Such estimates have been made by assuming an average thickness of coal for the whole area of the coal measures and then multiplying this thickness into such area. This method does not commend itself for further use, and, in general, we are of the opinion that the attempt to make such an estimate in the past was altogether premature, and would still be so now. We are not in a position to make as much as an approximate estimate in this direction, even were we to leave out of the question entirely the considerations affecting the availability of the coal in the present and in the future. The data necessary for such an estimate are the number of coal beds, their respective thicknesses, the area underlain by each bed, and the depth of each beneath the surface. Some of the principal causes restricting the distribution and availability of Missouri coals have been described in the preceding chapter of this report. To properly make such an estimate it is necessary that we define the nature and extent of such limiting causes, and this can only be done by the most detailed local work.

The question of the distribution and of the amount of coal in the State, is one which the State as a whole, as well as the individual property owner, cannot afford to neglect. Coal is, probably, of all others, the most substantial of a State's mineral possessions. Every industry is dependent upon it, and it is the mainspring of our 19th century civilization. In Great Britain, from the results of carefully executed geological surveys, estimates have been made by special commissions of the amount of coal in the United Kingdom, over 1 foot in thickness and situated within a depth of 4,000 feet beneath the surface.

An acre of ground contains for each foot of coal underlying it about 1,700 tons. With 2 feet of coal the tonnage per acre is 3,400 tons. With the methods of mining pursued generally in the State, certainly not less than 2,500 tons of these 3,400 tons could be marketed. This would be 1,600,000 tons per square mile, and thus the product from a 2-foot bed of coal, over an area of 2 square miles, would more than equal the present annual production for the whole State. Or, in other words, at the present rate of production, there is annually exhausted in the State an area of less than 2 square miles, and probably much less, inasmuch as the coal under a large part of the mining territory is 3 and 4 feet thick. The total area of the coal measures in the State, as already stated, is about 23,000 square miles. If only $\frac{1}{10}$ of this area be underlain by available coal 2 feet thick, the supply will be sufficient to furnish coal at

* In Eastern Texas and Southeastern Arkansas are large areas underlain by lignites, or brown coals. These have been in the past, only of limited local use. Recent investigations, by the Geological Survey of Texas, have shown that these lignites are equal in character to those which are widely used in Europe. They will probably become merchantable in the future. That they will be extensively substituted for Bituminous coals in the most important uses of the latter, is, however, an expectation which does not seem at present warranted.

the present rate of production for over 1,000 years. It is allowable to assume that a much larger area of available coal exists; but, on the other hand, the rate of production is constantly increasing, and will doubtless continue to do so for many years to come. Hence estimates of duration of supply can never be anything more than approximate and provisional. With the present indefiniteness as to the amount of coal present, even an approximate estimate cannot be presented. What is above given is offered merely as a suggestion.

The total value of the coal in the State must remain indeterminable until the question of the amount of the coal is settled. With a coal bed 2 feet thick the value of the 2,500 tons of available coal per acre, at $1.30 per ton, is $3,250. The value of the product of a square mile of such coal is $2,080,000. If we allow a profit of 10 cents per ton, the net value of the coal from an acre of such land is $250, and for 40 acres of such land it is $10,000. The value of the coal contents of such land, based upon the present market prices of the same substance, is thus many times what the land is valued at for farming purposes. Coal, however, is a possession which is not convertible until excavated and transported to market, and, until this is done, it represents just so much capital lying idle in the ground. Moreover, the coal of any one track cannot be opened upon, excavated and thus converted into ready money in a short time; but the work will proceed slowly and the returns will come in gradually from year to year. Thus, if a man owns a property of 40 acres, of which, according to our calculation, the net value of the coal is $10,000, and if he does not receive any of this $10,000 until the expiration of 15 years, then the present value of his land is a sum which at compound interest at current rates will amount to $10,000 in 15 years; this at 6 per cent. interest will be about $4,160, or about $100 per acre.

The exact time when a man may receive the full net value of the coal contents of his land depends upon many indefinite factors, such as the growth of facilities of transportation, the demand for the product, etc. It is thus impossible to give any one value per acre which will apply to all coal lands, even though their coal contents and the conditions under which it occurs be similar. Considering the conditions affecting the coal market already described, and, considering further, the undoubted prospect of a great growth of coal consumption in this and adjoining States, it would seem, however, a well assured fact that any and every large body of coal land may be made a profitable producer of coal during the course of a few years. Coal rights covering many square miles of land in the State have been purchased at the rate of a few dollars per acre, the amount seldom exceeding $5. In the case of a single large property, only a portion may be operated at any one time, but a moderate production from this portion, on a very small margin of profit per ton, will yield many times 6 per cent. on the amount of the original cost, not only of the area actually worked, but of a large surrounding area also. Thus, the original cost of the coal rights over 10 square miles, at $5 per acre, is $32,000. If the bed be only 2 feet thick, and if the coal underlying only 40 acres be removed per year, and sold at a profit of 10 cents per ton, the income would be $10,000, as above calculated, or about 30 per cent. of the total original investment. On the basis of these figures it is plain that the results of a few years' work, and the exhaustion of a very small fraction of the entire track, will suffice to return to the investor the total amount of the first cost of the coal land. The net receipts after this will continue to be large and will be clear profit.

Thus the coal lands of Missouri would seem to be promising fields for investment, even at rates much higher than have been so far maintained. The statistics of shipments show that the tendency is towards large operations by companies controlling thousands of acres of lands. Pursued on this large scale mining can be prosecuted undoubtedly much more economically and larger markets can be reached. The coal can also be sold on a smaller margin of profit, which is a benefit to the consumer. The small operator is sometimes, if not generally, the sufferer through such conditions; and, further, the small landowner is often, through lack of local competition, induced to part with his land, or its mining rights, to the adjacent large owner and operator at extremely low figures.

Once the value of these coal lands well established and their extent defined, however, wide interest will be excited and strong organizations will be led into keener competition for the possession of these lands than has heretofore been the case, and we may, therefore, look forward, in the march of events, to a large increase in the coal industry of the State, to profitable returns to those who invest their money sagaciously in coal lands and in the support of the dependent industry, and to an enhancement of the value of such lands now largely held and used purely for agricultural ends by private citizens of the State.

Coal-Handling Plant.

The Link Belt Engineering Company, Nicetown, Pa., have been very prominent of late years in the department of coal-conveying systems. Their latest achievement in this line is the new plant for the coaling station of the Philadelphia and Reading Railroad Company, at Lehigh avenue, Port Richmond, Philadelphia, which was completed and put into operation about 2 months ago, and was finally turned over to the railroad officials last month. The work presents some noteworthy features as being the most recent development of its class, and the first machine ever constructed which combines the hauling of coal and ashes, these operations having been hitherto performed by separate arrangements. The fact of manila rope being used on it for the transmission of power in place of leather belting or line shafting, although it has been previously used in other constructions by the company, is yet somewhat of a novelty in this country, and is one of their specialties. The coaling station in question was designed by the company and constructed at their Nicetown works. It has been built for the purpose of coaling the engines of the Philadelphia and Reading Railroad Company which are used in connection with the transport of coal and freight to and from the docks at Port Richmond; also has a capacity of 120 tons an hour, handling any description of coal, from dirt to steamboat, with equal facility. The station has a total length of 280 feet and is 14 feet 7 inches wide. The trucks laden with coal from the docks or store are brought alongside the station and discharge their contents directly into an open chute below the tracks; from the shute the coal is carried by buckets on an endless chain up an incline 95 feet long to the top of the station, and then transferred horizontally, the conveyors depositing the coal into a series of pockets on the standing frame work, 9 in number, each with a capacity of 50,000 pounds. From these pockets the fuel is conveyed by means of small swinging shutes into the tender, the whole operation being performed with the utmost ease and celerity. While the tenders are being filled the engines dump their hot ashes directly into sunken pockets, beneath the tracks, of which there are 6 on each side of the conveyor, which pockets empty into another series of conveyors, working up an incline 173 feet between centers placed above the coal conveyors, and dropping the ashes into a large steel pocket, occupying about ¼ of the frame work, with a gross capacity of 3,250 cubic feet, from whence they are shot into cars and carried away. The system is an improvement in and modification of other coal conveyors previously erected by the company in various parts of the country. One put up by them at Rondout, N. Y., for the Delaware and Hudson Canal Company, is now transferring 1,000 tons a day from lighters, the coal being dug out by the buckets automatically.

Ventilation.

Dr. William H. Thayer, of Brooklyn, recently caused the publication of some notes on what he terms "Errors in Ventilation." An abstract of his compilation is appended; and it is interesting to find that he quotes the ventilation of the former Hall of the Brooklyn Institute—it was damaged by fire about 2 years ago, and was completely demolished this year, because its removal was demanded by the improvements on the Southern terminal approaches to the East River Bridge—as the most perfect of any of the large public or semi-public buildings in Brooklyn. This perfection was brought about simply through an intelligent adaptation of the gas lighting arrangement as an aid to ventilation. The Doctor says:

"Let us go back to the law of the diffusion of gases, discovered by Dalton, the celebrated English chemist, and published by him in 1803. Wyman says: 'The discovery of this law has done much to establish the true principles of ventilation. Aeriform bodies possess the property of diffusing themselves through each other's masses to an unlimited extent; there is no point at which they become saturated. Mr. Dalton filled 2 cylindrical vessels, the one with carbonic acid, the other with hydrogen; the latter was placed perpendicularly over the former, and the 2 were connected together by means of a small tube 2 or 3 feet long. In the course of a few hours, hydrogen was detected in the lower vessel, and carbonic acid in the upper; after a still longer time, these gases were found perfectly and equally mixed. Carbonic acid is more than 20 times the weight of hydrogen; consequently the change of place was produced in opposition to the laws of gravity. This property belongs to all gases and vapors.

"Those who err in opinion are led astray by knowing that carbonic acid is found almost pure in old wells that are shut up, and in the famous Grotto del Cane, in Italy; forgetting that in those situations it is formed in the soil, from which it is constantly pouring more rapidly that it can be diffused through the neighboring atmosphere.

"We see that carbonic acid gas, although 50 per cent. heavier than common air, will be gradually diffused through the atmosphere, at whatever temperature. In the case of the air that is expired from our lungs, surcharged with carbonic acid, it rises at once in an active current to the highest part of the room, because it is expanded by its higher temperature to greater lightness than the air of the room. From the neighborhood of the ceiling it is very gradually diffused through every part of the room, but remains in excess at the top as long as the supply continues. To sustain this proposition, I will quote from good authorities from the beginning of the century down to the present time.

"Dr. Edward Turner, in his 'Elements of Chemistry,' says: 'There is no real foundation for the opinion that carbonic acid can separate itself from the great mass of the atmosphere, and accumulate in a low situation, merely by the force of gravity.'

"Dr. Neill Arnott, in his 'Elements of Physics,' says: 'The air which a man has once respired becomes poison to him; but because the temperature of his body is generally higher than that of the atmosphere around him, as soon as he has discharged any air from the lungs, it ascends completely away from him into the great purifying laboratory of the atmosphere, and new air takes its place * * * In a very close apartment ventilation must be expressly provided for by an opening near the ceiling, through which the impure air, rising from the respiration of the company, may pass away.'

"Walter N. Hartley, in his 'Air in its Relation to Life,' says: 'All the foulest air is near the ceiling; in fact, it is so bad there that unless an easy outlet be provided it becomes perfectly poisonous.'

"In 1869 Dr. R. Cresson Stiles, Assistant Sanitary Superintendent of the Metropolitan Board of Health, made a report on the qualities of the air of public buildings. He analyzed the air of public schools, hospitals, theaters, and churches, to ascertain the proportion of carbonic acid contained in it, and in some buildings measured the amount at different heights—near the floor and near the ceiling. His results varied with the different conditions of the rooms as to ventilation and air currents; but he says: 'Air taken from near the ceiling was always found more highly charged with carbonic acid than that in the lower portion of a room, and the difference was often very marked. * * * In the hall of the Hamilton Literary Asociation, on the occasion of a meeting of the Kings County Medical Society, about 80 persons present, air taken within a foot of the ceiling, after 3 hours' occupation, gave 3.1 parts of carbonic acid per 1,000, while that taken at the same time within 3 feet of the floor gave 1 part per 1,000.'

"I come now to the crucial test of the accuracy of those who expect to draw off the foul air from a building by outlets near the floor. The Church of St. Ann on the Heights, in Brooklyn, at the time of its construction, about 20 years ago, employed Mr. Leeds to ventilate it. He placed a pipe against the other wall, running the whole of the church on both sides, under the side galleries, about 4 feet from the floor, with an open grating in its whole length. These pipes are carried to the foot of the church tower, where they open into a perpendicular flue running up to the top of the tower, with gas lights at the base to heat the air and aid in the upward current.

"Dr. E. H. Bartly, Chemist of the Brooklyn Health Department, has kindly made analyses at my request of the air of St. Ann's at different heights, at a time when it was filled by the congregation. He writes:

"'The analysis of the air in St. Ann's Church this evening show on the floor, under the edge of the gallery, 19 parts of CO_2 in 10,000 of the air, while on the gallery, immediately over the place where the first sample was taken, it shows about 40 in 10,000. Duplicate examinations taken on January 3d, at the same hour—viz., at the close of the sermon, showed nearly the same results. These results show that the house is not well ventilated, and that, as would be expected, the CO_2 in the air in the gallery is much more than near the floor.'

"The carbonic acid in the air of our rooms resulting from respiration, in the limited amount in which it exists after diffusion, is not the sole or the chief injurious and dangerous element of that atmosphere. The organic matters which are contained in the expired air are more prejudicial to health; but as they are proportioned in amount to the accompanying carbonic acid, this gas 'is taken as a convenient index to the amount of the impurities.'

"The conclusion, from all the evidence adduced, is, that the carbonic acid gas of respiration and illumination will eventually be equally diffused through the atmosphere, although retained at the upper part of a room so long as the high temperature continues; and that it never, under any circumstances, is precipitated in excess to the lower part of the room.

"One's ordinary perceptions may be trusted for the extremes of atmospheric conditions of a room; one perceives at once the difference between a very foul atmospheric and a very pure one. The Hall of the Brooklyn Institute—burned last year—when occupied, impressed one on entering as having a delightful atmosphere. It was about 25 feet high, and ventilated by large openings in the ceiling over 2 chandeliers. The only objection to such an arrangement made by well-informed people is the waste of heat. But when we take into consideration the immediate comfort and the prospective advantage to the health of the occupants, it is no waste; it is a little more fuel, but it is a great deal less sickness."

[It is also worthy of note that the testimony here given is all in favor of the position assumed by Prof. E. G. Love, anent the question of the possibility of the stratification of gas; vide the article entitled "Do Gases Stratify?" published in the JOURNAL for December 7, 1891, page 806.]

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE following ringing letter from Mr. W. H. Pearson, General Manager and Secretary of the Consumers Gas Company, of Toronto, and Second Vice-President of the American Gas Light Association, explains itself so fully that comment on it or explanation of it would be more than superfluous:

THE CONSUMERS GAS COMPANY, OF TORONTO,
TORONTO, ONTARIO, June 27, 1892.

To the Editor AMERICAN GAS LIGHT JOURNAL: I have been not a little surprised to note, from the reports in your JOURNAL, the snail-like pace at which contributions to the Fair Fund have been coming in, and have wondered what has become of the proverbial pluck and enterprise of the American gas men. I have thought that perhaps a few words, coming from a Canadian whose Company has promised its full quota toward the holding of an Exhibition in another country, might be useful at this critical juncture, and shall endeavor to state and meet some of the objections which, in my opinion, have operated to prevent a general and generous response to the appeal of the Gas Industry Council, and make a few general remarks on the subject; and I trust that what I say will be in some measure helpful in bringing about a better state of affairs. It is quite possible that some gas companies have not contributed because they have considered that the manufacturers of stoves and apparatus ought to bear the whole expense of the exhibit. I hold that, while the latter certainly ought to be large contributors, the gas companies have almost, if not quite, an equal interest with them; for it is obvious that the greater the number of gas appliances sold the larger will be the consumption of gas. Others may be holding back with the idea that the Exhibition will only be of advantage to the gas companies in the place in which it is held; and probably this objection prevails more fully than any other. I am glad that I happen to be in a position to know that such an opinion is an erroneous one, and that I am able to state that when our Company, some 9 years ago, and for several years afterward, made gas exhibits at our Industrial Exhibition in this city, a very large proportion of those who inspected and took a great interest in it were parties from outside places; and that as a result many other gas companies were much benefited. As far as the proposed exhibit at Chicago is concerned, I am satisfied that there will not be a gas town in the whole of the United States and Canada which will not be largely represented there by gas consumers. The Exhibition at Chicago will, therefore, doubtless largely answer the purpose of a local one—indeed, in some respects it would do much more; for in no other locality, owing to the circumstances, could such a comprehensive display be made. If any gas companies are contemplating making a local exhibit, would it not be better for them to contribute toward the central exhibit at Chicago a less amount than would be required for a respectable exhibit of their own, and be saved all the trouble in connection therewith, with perhaps equally beneficial results? Now, a fairly respectable local exhibit could not be made for less than $500, while the pro rata contribution asked from a company with an output of 50 million cubic feet per annum is only $200. I hardly think that any company can be holding back because of a belief in the inutility of exhibitions, for everyone is satisfied as to the benefits of judicious advertising; and such an exhibit as the proposed one would be the best of advertisements. Our Company has spent over $3,000 in local exhibitions, and I have ample evidence that it has received back the amount over and over again in profits on increased gas sales. Some companies may decline contributing on the ground that it would not be right to expend the stockholders' money. Certainly not, if there was not the prospect of their receiving some corresponding advantage thereby; but in this case it would be one of the best investments that could be made. Others may be holding

back with the idea that there will be an exhibition anyway, and that they may as well get the benefit at the other companies' expense. I should hope that such companies are few in number. Again, others may think that too much is being attempted, and, therefore, withhold contributions, while they would be willing to give to a less pretentious scheme. In answer, I would say that the occasion is an unparalleled one, that the exhibit would be open to the criticism of the whole world, that it would be better to have no exhibit unless it was a creditable one, and that even what is proposed will, in extent, fall far short of the electrical exhibition. An important feature in connection with this proposed gas exhibition which must not be lost sight of is that it will be decidedly educational, and no gas man can go to such an exhibition without learning much that will be to his own and his company's benefit. Another important object aimed at by the promoters of the proposed exhibit is to show that as an exhibit, gas is not to be relegated to a back seat, but that, by the use of suitable burners, it is for general use far superior, and, in most places, very much cheaper than its competitors. For manufacturers of gas and gas apparatus not to make a gas exhibit at the World's Fair would be to lose one of the grandest opportunities that could possibly be secured, and it could not but be seriously detrimental to their interests, for it would be construed by the general public into a tacit admission of the superiority of electric lighting. *We cannot afford to do without an exhibit.* That the Chicago Companies, who would be more especially benefited, should decline to contribute toward the Fund is, to me, a most astonishing and short-sighted policy, and it would seem to me that the holding or non-holding of the proposed exhibit depends very largely upon the course which they will take. Are they prepared to take the responsibility of there being no exhibit? It is to be hoped not.—Yours truly, W. H. Pearson.

Mr. John Thompson has been chosen to succeed the late Mr. Whidden as President of the East Boston (Mass.) Gas Company. Mr. Thompson stands very high in the esteem of the community. He has been in active business in East Boston for many years.

Mr. A. M. Sutherland, General Superintendent of the National Gas Investment Company, No. 115 Broadway, N. Y., writing under date of June 28th, says:

To the Editor of the American Gas Light Journal: I understand that there is a story going the rounds among gas men to the effect that I am or have been engaged in selling gold mining and other speculative stocks of little or no value. Such an impression, if allowed to go unchecked, would do me great injury, and as the most direct method of reaching the gas fraternity I appeal to you to do me justice. I am glad to be able to say that I am *not now and never have been* engaged in selling gold mining or *any other stocks, good or bad.* I have been frequently asked for stock in the Company to which I had sold my first gas patents. With one exception my answer was, "No; if that stock should have no value I would not sell it to you; and if it should turn out valuable I need it myself." The one exception was when I was prevailed on to sell 200 shares to an old acquaintance (Mr. Hugh J. Adams, dealer in pig iron, whose offices are in Pine street) with the understanding that, if he desired it during a year from that time, I should pay it back and take the stock. He did so desire, and I immediately paid the money back, with interest. These are the facts.

We are indebted to Mr. J. H. Fitzgerald, of the Houston (Tex.) Gas Light Company, for the information that at a recent meeting of the Board of Directors of that Company, Mr. Vaughan tendered his resignation as Secretary, Treasurer and Manager, which was reluctantly accepted. The resignation, which was very unexpected, took effect on July 1st, and Mr. J. J. McKeever has been appointed to the positions vacated by Mr. Vaughan. As an evidence of the high esteem in which Mr. Vaughan is held as a citizen, and of his eminent qualifications as a courteous and dutiful business man and officer, the following resolutions were adopted by the Directory: "Be it resolved by the Board of Directors of the Houston Gas Light Company that in accepting the resignation of Mr. George R. Vaughan as Secretary, Treasurer and Manager of the Company, the Board does so with sincere regret; that during the time he has been in the employ of this Company he has been at all times faithful, energetic and true to every trust, and the Board of Directors commend him to all persons with whom he may become associated as a gentleman worthy of all confidence." Mr. Vaughan goes to Mobile, Ala., there to assume the Presidency of a large wholesale hardware enterprise.

Mr. Fitzgerald also says: "Mr. Vaughan has been in the service of the Houston Gas Light Company about seven years, and his resignation is not only regretted by the Directors and his many friends and acquaintances, but particularly by those who were his everyday associates and assistants in the conduct of the Company's business."

To these pleasant words of the Company and its officers respecting Mr. Vaughan we would like to add on our own account that we have had some very pleasant business relations with the gentleman, who is widely known amongst the Southwestern fraternity more particularly, and we hope and believe that his measure of success in his new field will be up to that gained by him during his active connection with the gas industry.

The proprietors of the Hudson (N. Y.) Light and Power Company have determined to pay more attention to the gas division—about a year or so ago the Gas Company was absorbed by the local Electric Lighting Company—of their business, and are making some needed plant improvements. The gas supply of Hudson ought to be a renumerative undertaking.

The Waterbury (Conn.) Brass Company is putting up a new wire mill, which is to be constructed of iron by the Berlin Iron Bridge Company, of East Berlin, Conn., from designs arranged by the Bridge Company. The rolling mill will be 100 feet wide by 160 feet in length, with a wing (to be used for drawing wire) 40 feet wide by 230 feet long.

The Newport (R. I.) Gas Company is constructing a new wharf on the Wellington avenue site.

A correspondent forwards the following respecting the favor which the gas engine enjoys as a moter power in Aberdeen, Scotland: Gas engines have become highly popular in Aberdeen, where no fewer than 9 of the Otto type alone have been sold since the month of March—two for driving machines, two for grinding machinery, one for wood turning, one for driving ventilating fans in a boarding school, and two for Messrs. Harper's new works at Craiginches. The two last are each of 35-horse power nominal, and are capable of indicating together 200-horse power. One of them is to be used for driving the whole of the machinery in the new works, and the other for driving the electric lighting machinery.

The following table of rates charged for public lighting, in the named Canadian cities, will be of interest. The lamps are in duty all night and every night of the year.

City.	Candle Power.	No. Lamps.	Rate per Night.
Brockville	2,000	29	35 cents.
Brantford	2,000	29	28¼ "
Belleville	2,000	41	28¼ "
Chatham	2,000	49	33 "
Hamilton	2,000	310	28 "
Kingston	2,000	?	28 "
London	2,000	275	28½ "
Ottawa	2,000	300	30 "
Owen Sound	1,200	30	24½ "
Quebec	1,200	308	22 "
Sherbrooke	2,000	52	34 "
St. Catharines	2,000	62	30 "
St. John, N. B.	2,000	220	25½ "
St. John's, Newfoundland	2,000	43	42⅜ "
Toronto	2,000	965	29¼ "
Winnipeg	2,000	100	75 "

The Committees on Light, Law and Contracts, of the Cincinnati Board of Legislation, after considerable joint deliberation on the matter of amending and extending the contract between the city and the Cincinnati Gas Light and Coke Company, in regard to the life and rate of the period and charge that the latter shall make to gas consumers, reported that—the existing contract does not expire until March, 1897—if the Company, which now may charge ordinary consumers the sum of $1.25 per 1,000 gross, with 10 cents off for prompt payment, would agree to accept an extension of its contract for 5 years, from March, 1897, and would also agree to reduce the gross rate to $1.10 gross, or $1 net, from the current time, and until 1902, an ordinance in accordance therewith would be recommended. The Company accepted the stipulations whereupon the Board passed the ordinance. Under this agreement the Company's charge for gas will be $1.10 per 1,000 feet, with 10 cents off for prompt payment, during the next 10 years, or until General Hickenlooper sees his way clear to advising another reduction, which advice will undoubtedly be given prior to March 1, 1902.

The Board of Gas and Electric Light Commissioners will hear testimony on the petition for a reduction in the Boston gas rate, on the morning of September 10th, at the State House. Messrs. Robert M.

Morse and Moody Merrill will manage the case for the petitioners, and Mr. A. B. Coffin will argue for the Boston Gas Company.

DR. E. G. LOVE, official gas examiner for this city, will sail for Europe on the 14th inst.

PRESS despatches to the New York papers under date of June 27th are to the effect that a syndicate composed of Boston and New York capitalists has purchased "the holdings of Milwaukee people in the Milwaukee (Wis.) Gas Light Company, and are now negotiating with Eastern holders for their stock. The price brought by the Milwaukee holdings exceeds $1,000,000, and the entire deal involves an investment of fully $3,000,000." We give this for what it is worth, but are inclined to the view that when the "entire deal" is fully explained it will be shown that many of those connected with the Company in the past will be very potent factors in its future.

A CONCERN known as the Hecla Compressed Gas Company has been organized at Kittery, Maine, for the avowed purpose of manufacturing and dealing in compressed gases and articles and products of the same. It is capitalized in $100,000, of which $50 is paid in. The officers are: President, Gustaf Olsson, of Everett, Mass.; Treasurer, John A. Brown, Everett, Mass.

THE proprietors of the corn-cob and potato juice extract gas making process, the career of which at New Bedford, Mass., was recently cut short by the decision of the Board of Gas and Electric Light Commissioners, propose to remove the "plant" to Fairhaven, which is connected with the Whaling City by a long bridge. It may "do" for Fair haven; but we doubt it.

THE Lynn (Mass.) Gas and Electric Company's proprietors are very much pleased with the results that followed Secretary and Treasurer Prichard's latest exposition of the virtues and economies of gas as a domestic agent. The Prichard programme this year provided for two lectures, practically illustrated, by Miss Daniell, Principal of the Boston School of Economic and Sanitary Cooking, the first of which was given on the afternoon of Saturday, June 18, the second being rendered on the afternoon of Monday, June 20. The lectures were given in the handsome Hall of the Young Mens' Christian Association and the lecturess and the Company were gratified by a large attendance of the matrons and the maids of the city. The programme of the first lecture included the preparation and serving of the following lunch: Filet of halibut, *a la poulette*; broiled beef steak; cream sauce; potato balls; luncheon muffins. The programme of the second lecture was for the following dinner: Puree of peas; roast beef; browned potatoes; tomato salad, french dressing; wigwam pudding. As remarked before both lectures were well attended, and everything was carried out in spirited and flawless style.

IT is worthy of note, too, that the Lynn Company maintains a handsomely fitted up store, at No. 82 Exchange street, where a large and varied assortment of gas cooking and heating appliances, burners, globes, shades, etc., is maintained, all in charge of a competent person who is instructed to spare no pains in explaining fully to visitors all about the apparatus in which the visitor is interested.

FRANK RICHARDSON, at North Adams, Mass., is also paying great attention this season to increasing the use of gas for domestic purposes. His methods, as usual with him, are of the precise and business like sort, and his success has been pronounced. In fact, judging from what he has so far accomplished in this line during the early summer, no one can justly accuse him of pushing the electric light output at the expense of the gas section.

THE San Francisco (Cal.) Gas Light Company has brought suit against Jos. Harmes to enjoin him from interfering with its main, on Shasta street, between Michigan and Illinois streets, laid down in 1870, and through which is conveyed about ½ of the gas distributed in the city. This main is supported in place by the subjacent soil of the street, which Harmes has threatened to excavate in the grading of the street at the point noted.

THE Des Moines (Ia.) City Council is determined to keep the gas rate question prominent, for the ink was little more than dry on Judge Conrad's syllabus, deciding that the $1.25 gas rate was an unreasonably low one, when the Council passed another ordinance fixing the gross rate at $1.45 per 1,000, with 10 cents off for prompt payment. It is likely the Capital City Gas Company will again appeal to the courts.

SUPPLEMENTING our intimation of a week ago that we were in receipt of a paper weight in glass from the P. H. & F. M. Roots Company, of Connersville, Ind., we call attention to the fact that the Roots Company has forwarded like specimens to every gas company in America. However, if any of the "weights" sent should fail to have been received, the Company will, on receipt of a postal card containing the address of the sender, forward a duplicate. It pleases us to add that the business of the Roots Company bids fair to be larger this year than any ever enjoyed by it.

ANOTHER of the Eastern men who has paid close attention to the development of a demand for gas for purposes other than that of illumination is Mr. C. J. R. Humphreys, who, although one of the "youngsters" of the industry, was always one of the most progressive. To our own personal knowledge, for the past fifteen years, by tongue, pen and practice, he has advocated this principle, and how well he has succeeded is best shown by pointing to the success scored by him in the placing of gas stoves in the busy city of Lawrence, Mass., the gas supply of which is in the hands of the Company he so cleverly manages. This year—and it pleases us all to know that Mr. Humphreys is physically himself again—he returns to the charge with renewed vigor, the most pronounced feature of his campaign being the compilation of a pamphlet detailing in chatty and terse sentences the ways and means of causing gas to take on increased value as a household aid. The pamphlet, which is a beautiful specimen of the printers' art, is illustrated with cuts of gas cookers, broilers, etc., and the operation, or the way in which to operate the apparatus, is clearly described. It also contains receipts, prepared by Miss Anna Barrows, for getting up "gas stove dinners" and luncheon bric-a-brac—if we may be forgiven for so saying. This pamphlet has been liberally distributed, and we have no doubt that Mr. H. could be prevailed upon to furnish duplicates of it to other companies. He also avails himself of the columns of the local newspapers to catch the consumer's eye, and we also note that his Company sells gas stoves on the installment plan which looks to us to be an extremely clever way of putting these useful appliances out in service.

AN explosion is reported at the works of the Ellenville (N. Y.) Gas Light Company, but we do not believe that any great loss was incurred. A reporter of the Middletown (N. Y.) *Mercury*, in putting the facts before that paper's readers, gave the following as the cause of the overturning: "The sandbox in which the gas accumulates before being transferred to the tank, burst with great force," etc. And there you have it.

A RE-ADJUSTMENT of the affairs of the Goodwin Gas Stove and Meter Company is in progress, with Mr. Hector T. Fenton in charge of the same.

WE understand that the New York Steam Company is again in the market for more capital, with the likelihood that it will have to get new names on its promissory notes. Mention of this recalls the fact that the Hartford (Conn.) Steam Company is now virtually under control of the Hartford Electric Light and Power Company, and that the Springfield (Mass.) Steam Company is a worse drag than ever on the earning powers of the Springfield Gas Company, with which its fortunes are closely linked—more's the pity.

ABOUT the busiest firm in the East that is concerned in the manufacture of gas works apparatus is the Davis & Farnum Manufacturing Company. Here is a partial list of the orders on its books:

Charlestown (Mass.) Gas and Electric Co., four 20 ft. by 15 ft. purifiers and connections complete, including 2 floor carriages; Brookline (Mass.) Gas Light Co., four 20 ft. by 16 ft. purifiers, and hydraulic hoisting carriage; American Watch Co., Waltham, Mass., set of purifiers, 12 ft. by 6 ft. and 12 inch valve connections, and a 78 inch station meter; Jamaica Plain (Mass.) Gas Light Co., purifier covers and bench work; Portsmouth (N. H.) Gas Light Co., set purifiers and connections, No. 4 Wilbraham exhauster and engine, a 5 ft. 6 in. station meter, and a sinuous friction condenser; Malden and Melrose (Mass.) Gas Co., 3 benches, iron roof and washer; East Boston (Mass.) Gas Co., 4 benches of 6's; Chelsea (Mass.) Gas Light Co., 3 benches 6's; Fitchburg (Mass.) Gas and Electric Co., bench work; Rondout and Kingston (N. Y.) Gas Co., bench work; North Adams (Mass.) Gas and Electric Light Co., bench work; Bath (Me.) Gas and Electric Co., a holder, 3 benches, exhauster, street governor and condenser; Lyons (N. Y.) Gas Light Co., gasholder; Nantucket (Mass.) Gas Light Co., holder, benches and station meter; Bangor (Me.) Gas Light Co., sinuous friction condenser; Concord (N. H.) Gas Light Co., steel tank for gasholder; Lynn (Mass.) Gas and Electric Co., iron work for 8 benches of 6's; Adams (Mass.) Gas Light Co., bench work; Holyoke (Mass.) Gas Co., bench work; Newport (R. I.) Gas Light Co., steel beams, iron flooring, etc.; Pittsfield (Mass.) Coal Gas Co., four 9 feet by 11 feet purifiers and seal connections, and one 66 inch station meter; Citizens Gas Light Co., Wakefield, Mass., benchwork; Athol (Mass.) Gas and Electric Co., gasholder; Peoples Gas and Electric Co., Canton, Ills., gasholder and washer; also, many smaller orders, with several larger ones in sight.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

MONDAY, JULY 4, 1892.

The Market for Gas Securities.

There was marked inquiry for Mutual during the week, which advanced sharply to 146 bid, holders, however, refusing to consider anything less than 150. No doubt this was caused by the action taken by the management in declaring an extra dividend of 1 per cent., in addition to the regular semi-annual dividend of 3 per cent., both of which are payable on and after July 10th. Equitable is also in much demand, and from present indications it would not be out of bounds to predict that 175 will be made in it before the end of the year. Consolidated stands up to the rates recently quoted.

In Brooklyn, strength characterizes the situation, save in respect to Brooklyn gas, for which only 135 is bid. Perhaps we might add that Nassau is not quite as firm as it was a week ago. In this connection the fraternity will rejoice with us at the marked improvement in the condition of Col. "Fred." S. Benson, the Nassau Company's talented engineer. At one time his illness gave his friends much concern. Consolidated of Baltimore is about as before, with no great demand for the shares. We repeat it that this stock is a purchase. Owing to manipulation, Chicago gas declined sharply towards the close of the week, but the talk of a receiver is simple bosh. The general market is strong.

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City ... 33
Wm. Henry White, New York City ... 31
Fred. Bredel, New York City ... 27
H. C Slaney, New York City ... 33
J. R. Smedberg, Peoria, Ills ... 33

GAS AND WATER PIPES.

Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) ... 35
Ohio Pipe Co., Columbus, Ohio ... 25
M. J. Drummond, New York City ... 25
R. D. Wood & Co., Phila., Pa ... 25
Warren Foundry & Machine Co., New York City ... 25
Donaldson Iron Co., Emaus, Pa ... 25
Addyston Pipe and Steel Co., Cincinnati, O ... 25
Detroit Pipe and Foundry Co. Detroit, Mich ... 25

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills ... 22
Bartlett, Hayward & Co., Baltimore, Md ... 29
United Gas Improvement Co., Phila, Pa ... 21
Burdett Loomis, Hartford, Conn ... 31
National Gas and Water Co., Chicago, Ills ... 23
A. M. Sutherland, New York City ... 15

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City ... 31
Continental Iron Works, Brooklyn, N. Y ... 16
Delly & Fowler, Phila., Pa ... 31
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 28
Stacey Mfg. Co., Cincinnati, Ohio ... 31
Bartlett, Hayward & Co., Baltimore, Md ... 29
Morris, Tasker & Co., Limited, Phila., Pa ... 29
Davis & Farnum Mfg. Co., Waltham, Mass ... 28
R. D. Wood & Co., Phila., Pa ... 30
Bouton Foundry Co., Chicago, Ills ... 31
Isbell-Porter Company, New York City ... 30
Fred. Bredel, New York City ... 27
United Gas Improvement Co., Phila., Pa ... 21
National Gas Light and Fuel Co., Chicago, Ills ... 22
Berlin Iron Bridge Company East Berlin, Conn ... 18
National Gas and Water Co., Chicago, Ills ... 23
The Gas Works Construction Co., New York City ... 15

ELEVATORS, CONVEYORS, ETC.

Link-Belt Machinery Co ... 15

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City ... 18

GAS COALS.

Penn Gas Coal Co., Phila., Pa ... 33
Perkins & Co., New York City ... 32
Despard Coal Coal, Baltimore, Md ... 33
Chesapeake and Ohio R. R. Coal Agency, N. Y. City ... 33
Westmoreland Coal Company, Phila., Pa ... 33
J. & W. Wood, New York City ... 32

CANNEL COALS.

Perkins & Co., New York City ... 32
J. & W. Wood, New York City ... 32

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio ... 33

COKE CRUSHER.

C. M. Keller, Columbus, Ind ... 32

INCLINED RETORTS.

Parker-Russell M'ning and Mfg. Co., St. Louis, Mo ... 26

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J ... 26
B. Kreischer & Sons, New York City ... 26
Adam Weber, New York City ... 26
Laclede Fire Brick Mfg. Co, St. Louis, Mo ... 26
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y ... 26
Borgner & O'Brien, Phila., Pa ... 26
James Gardner, Jr., Pittsburgh, Pa ... 26
Henry Maurer & Son, New York City ... 26
Baltimore Retort and Fire Brick Co., Baltimore, Md ... 26
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 26

GASHOLDER TANKS.

W. C. Whyte, New York City ... 22
J. P. Whittier, Brooklyn, N. Y ... 20

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass ... 18

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y ... 26

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City ... 936
R. D. Wood & Co., Phila., Pa ... 30
James R. Floyd & Sons, New York City ... 24
Continental Iron Works, Brooklyn, N. Y ... 16

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 29
Fred. Bredel, New York City ... 27
J. H. Gautier & Co., Jersey City, N. J ... 27
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 26

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City ... 23
Wilbraham Bros., Phila., Pa ... 23

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page's Sons, N. Y. City ... 20

COAL TAR.

J. W. Ford, Chicago, Ill ... 15

AMMONIA CONCENTRATOR.

Michigan Ammonia Works, Detroit, Mich ... 15

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 34
American Meter Co., New York and Philadelphia ... 35
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa ... 36
Helme & McIlhenny, Phila, Pa ... 35
D. McDonald & Co., Albany, N. Y ... 35
Nathaniel Tufts, Boston, Mass ... 34
Maryland Meter and Manufacturing Co., Baltimore, Md ... 34
Harris Bros. & Co., Philadelphia, Pa ... 34
Keystone Meter Co., Royersford, Pa ... 35

METER REGISTERS.

Meter Register Co., Chicago, Ills ... 15

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City ... 30
Continental Iron Works, Brooklyn, N. Y ... 16

BURNERS.

C. A. Gefroror, Phila., Pa ... 25
Moses G. Wilder, Phila., Pa ... 15
Non-Corrosive Gas Tip Co., Boston, Mass ... 931

STREET LAMPS.

J. G. Miner, Morrisania New York City ... 27
Bartlett Street Lamp Mfg. Co., New York City ... 27

PURIFYING MATERIAL.

Connelly Iron Sponge and Governor Co., New York City ... 23
Greenpoint Chemical Works, Brooklyn, N. Y ... 23

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City ... 31
Fort Wayne Electric Co., Fort Wayne, Ind ... 24
Weston Electrical Instrument Co., Newark, N. J ... 25

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind ... 20
Isbell-Porter Company, New York City ... 30
Wilbraham Bros., Philadelphia, Pa ... 23
Connelly Iron Sponge and Governor Co., New York City ... 23

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 25
Chapman Valve Manufacturing Co., Boston, Mass ... 25
R. D. Wood & Co., Phila., Pa ... 30
The P. H. & F. M. Roots Co., Connersville, Ind ... 936
Continental Iron Works, Brooklyn, N. Y ... 16

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa ... 952

ENGINES AND BOILERS.

Jarvis Engineering Co. Boston, Mass ... 23
The Hazelton Boiler Co., New York City ... 16

PURIFIER SCREENS.

John Cabot, New York City ... 25

GAS STOVES.

American Meter Co., New York and Philadelphia ... 19
The Goodwin Gas Stove and Meter Co, Phila., Pa ... 36
George M. Clark & Co., Chicago, Ills ... 17
Maryland Meter and Manufacturing Co., Baltimore, Md ... 34

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., PA, June 24, 1892.

The Directors have this day declared a quarterly dividend of two (2) per cent. ($1 per share), payable July 15, 1892, to stockholders of record at close of business July 5.

891-2 EDWARD C. LEE, Treasurer.

Position Wanted

A man of 40, having extensive experience as manager, engineer, and superintendent of construction and operations in detail for

Gas, Electric, Water and Rapid Transit Plants,

wishes a position with a reliable Company or Firm. Is sober, active and reliable, and a thorough, practical and skilled mechanic, with a good knowledge of inventions and improvements. First-class references given and required. Address

891-9 "H. O. C.," care this Journal.

WANTED,

By an active, middle-aged man, who has spent his whole life in building and managing gas works, a

Situation as Superintendent

or a subordinate position. Would work for a moderate salary, or would lease a works. Can give ample references. Address

891-1 "ENGINEER," care this Office.

Situation Wanted

An American, aged 40, who has some technical education and is a machinist by trade, desires to secure a position likely to be permanent and not require traveling. Has had 5 years' experience as engineer in charge of gas works construction, has been successful in getting tight masonry holder tanks, also putting in foundations and buildings for and erecting water gas and other gas apparatus; understands the manufacture of water gas; has erected compound condensing engines for electric light plant, and had 12 years' experience at general mining work. Address

890-2 "CAPTAIN," care this Journal.

FOR SALE.

Six Oil Tanks, 4 ft. diameter by 30 ft. long.
One Oil Tank, 5 ft. diameter by 26 ft. long.
One Station Meter, 500,000 cu. ft. capacity.

All the above in good condition. Further particulars may be had by addressing THE NEW HAVEN GAS LT. CO.,

889-tf New Haven, Conn.

WANTED,

A Second-Hand Station Meter,

In good order, and warranted to register correctly 500,000 cubic feet in 24 hours; 12-inch connections. Address

889-3t D. G. L. CO., care this Journal.

AN OPPORTUNITY.

THE BOSTON GAS LIGHT COMPANY, HAVING ABANDONED THE USE OF

32 Benches 6's,

(16 benches back to back, mouthpieces 12 in. by 24 in.)

DESIRE TO DISPOSE OF ALL THE IRONWORK THEREOF,

Hydraulic Mains, Stand-Pipes, Bridge-Pipes, Lids, Etc., Etc.

Dimensions on application. Address at once,

ENGINEER, B. G. L. CO.,

890-2 24 West Street, Boston, Mass.

FOR SALE,

A Connelly Six-Inch Jet Exhauster,

In first-class condition, only two years used.

Address "EXHAUSTER,"

890-3 Room 49, 115 Broadway, N. Y. City.

FOR SALE,

A Gasholder,

65 ft. diameter and 20 feet deep, with columns and girders. The holder is in a fair state of preservation, and could be taken down and erected in some small city or town.

ST. JOSEPH GAS AND MFG. CO.,

855-tf K. M. MITCHELL, Supt., St. Joseph, Mo.

Coal Tar.

J. W. FORD,

153 Washington Street, Chicago, Ill.,

Is always ready to buy Coal Tar.

Link-Belt Machinery Co.

CHICAGO, ILL.,

Will be pleased to furnish designs of

Elevating and Conveying Machinery

For the economical handling of Coal, Coke, Oxide, etc. in Gas Plants.

THE GAS WORKS CONSTRUCTION CO.

ENGINEERS AND CONTRACTORS

FOR THE

Erection of New or the Rebuilding of Old Works.

LAYING of CAST or WROUGHT IRON STREET MAINS.

Special Attention Paid to the Building of Holder Tanks.

Plans, Specifications and Estimates Furnished on Application.

2, 4 & 6 College Place, Room 7, N.Y.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

MOSES G. WILDER, MECH. ENGR.

816-18-20-22 Cherry St., Phila., Pa.

Volumetric Lamp Governors

FOR GAS LAMPS & HIGH-POWER BURNERS.

GOVERNOR BURNERS
for
STREET LAMPS AND GENERAL USE,
and
GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

HORIZONTAL Governors

Specially adapted for
GAS STOVES, FURNACES, Etc., Etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

Correspondence Solicited with all who require a Reliable Governor.

METER REGISTER.

Stamps the dials, pointers and number of the meter on a card direct from the Meter.

Makes a permanent reading in which there is no possibility of mistake.

Saves all expense and trouble of re-readings.

Meter Reader does not have to use light or pen.

It is an absolute check against getting the readings crossed.

It will increase the consumption of gas by reducing the friction between consumer and supplier.

METER REGISTER CO., 52 to 56 Illinois St., Chicago, Ill.

THE "LITTLE GIANT" WATER GAS GENERATOR.

In order to correct some of the drawbacks in existing apparatus, and to bring Water Gas Generators within the reach of all Gas Companies, I have completed a Gas Generator (which can be seen in daily operation) having many advantages over all others.

This Generator takes but little room. It requires no change to be made in the height or depth of gas houses. It is more easily repaired when necessary. It is simpler and easier operated. It makes *more good gas from a given quantity of stock.* It makes good gas from *cheaper stock.* It makes gas of *any desired candle power* up to thirty without smoke. It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.* I build these Generators with any required capacity from 3,000 cubic feet per hour upward.

In more than one-half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours,* all the gas needed for the *twenty-four* hours.

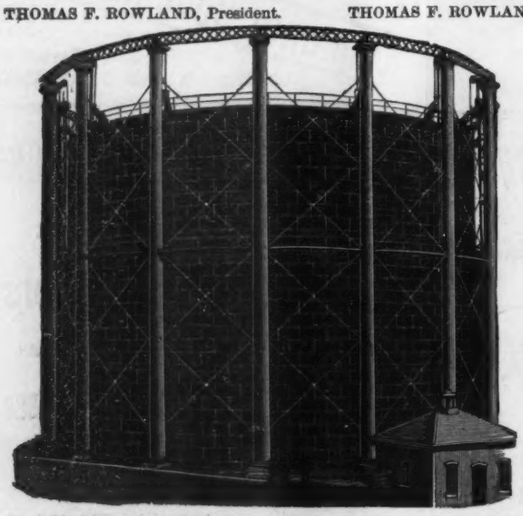
I have decided to take orders for these Generators for the balance of this season at *one half the price of any other* Water Gas Generator of equal capacity now on the market. After that the price shall be raised. *Everything is guaranteed,* including durability and capacity of the Generator, the quality of the gas, and its cost.

Correspondence solicited.

A. M. SUTHERLAND, - - No. 115 Broadway, N. Y. City.

The Continental Iron Works

THOMAS F. ROWLAND, President. THOMAS F. ROWLAND, Jr., Secretary & Treasurer. WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.



BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM NEW YORK TO GREENPOINT.

BUILDERS OF

GAS HOLDERS.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

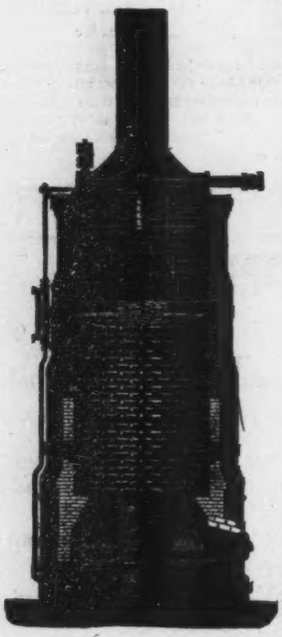
Hydraulic Mains, Condensers, Scrubbers. Purifiers, Valves, Etc., Etc.

SELF-SEALING RETORT MOUTHPIECES & LIDS

For Round, Oval, or "D" Retorts.

THE HAZELTON BOILER.

The Handiest, Safest, and Most Economical Boiler.



THE HIGHEST STANDARD OF EXCELLENCE.

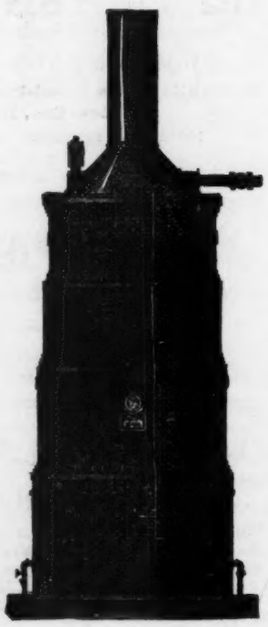
Patented in the United States and Foreign Countries.

THREE REGISTERED

THE HAZELTON BOILER.

THE PORCUPINE BOILER.

TRADE MARKS.



All Genuine Hazelton or Porcupine Boilers bear our Three Registered Trade Marks.

BEWARE OF IMITATIONS.

THE HAZELTON BOILER CO.,

MANUFACTURERS AND SOLE PROPRIETORS,

General Office, 716 E. Thirteenth St., Works, Avenue D and Thirteenth St., **New York, U.S.A.**

This Company is prepared to furnish Plants of Boilers of any desired capacity; solicits inspection of those now in operation, and will forward proposals and other information on application. All imitations of the substantial features of this boiler are infringements, and will be prosecuted to the full extent of the law. *Correspondence Solicited.*

The following are a few of the Gas Companies using this Boiler:

THE NEW YORK MUTUAL GAS LIGHT COMPANY	New York City.
THE NORTH ADAMS GAS LIGHT COMPANY	North Adams, Mass.
THE WASHINGTON GAS LIGHT COMPANY	Washington, D. C.
CONSOLIDATED GAS COMPANY	New York City.
CONSOLIDATED GAS AND ELECTRIC COMPANY	Port Chester N. Y.
HUDSON COUNTY GAS LIGHT COMPANY	Hoboken, N. J.
HAVERHILL GAS COMPANY	Haverhill, Mass.
ST. PAUL GAS LIGHT COMPANY	St. Paul, Minn.
NEWARK GAS LIGHT COMPANY	Newark, N. J.
CONSOLIDATED GAS COMPANY	Baltimore, Md.
NASSAU GAS LIGHT COMPANY	Brooklyn, N. Y.
MILWAUKEE GAS LIGHT COMPANY	Milwaukee, Wis.
PITTSBURGH GAS LIGHT COMPANY	Pittsburgh, Pa.
MUTUAL FUEL GAS COMPANY	Chicago, Ill.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

Jewel Gas Stoves

ARE THE BEST.

MADE IN FIFTY-SEVEN STYLES.

Prices from 75 Cents to $66.00.

For Details we refer to the Jewel 1892 Catalog.

JEWEL FEATURES ARE:

Burners with Sawed Slots. Direct Needle Valves.

Good Mechanical Construction.

GEORGE M. CLARK & COMPANY,

Makers,

157-161 Superior Street,

CHICAGO.

SCIENTIFIC BOOKS.

KING'S TREATISE ON THE MANUFACTURE OF COAL GAS. Three vols.; $10 per vol.

GAS MANUFACTURE, by WILLIAM RICHARDS. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S GUIDE. $1.

GAS CONSUMER'S HANDBOOK, by WILLIAM RICHARDS, C.E.; 18mo., Sewed. 20 cents.

A PRACTICAL TREATISE ON GAS AND VENTILATION with Special Relation to Illuminating, Heating, and Cooking by Gas, by E. E. PERKINS. $1.25.

CHEMISTRY OF ILLUMINATING GAS, by NORTON H. HUMPHRYS. $2.40.

PRACTICAL TREATISE ON HEAT, by THOMAS BOX. Second edition. $5.

STRAINS IN IRONWORK, by H. ADAMS. With plates. $1.75

GAS WORKS—THEIR ARRANGEMENT, CONSTRUCTION, PLANT, AND MACHINERY. $8.

COAL; ITS HISTORY AND USE, by PROF. THORPE. $3.50.

THE GAS WORKS OF LONDON, by COLBURN. 60 cents.

HEAT A MODE OF MOTION, by JOHN TYNDALL. $2.50.

MUNICIPAL LIGHTING, by F. H. WHIPPLE. $1.

THE MANAGEMENT OF SMALL GAS WORKS, by C. J. R. HUMPHREYS. $1.

MANUAL FOR GAS ENGINEERING STUDENTS, by D. LEE, 40 cents.

THEORY OF HEAT, by J. CLERK-MAXWELL. $1.25.

THE DOMESTIC USES OF COAL GAS, AS APPLIED TO LIGHTING, by W. SUGG. $1.40.

DIGEST OF GAS LAW. $5.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR, by GEO. LUNGE. New Edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS, by D. A. GRAHAM 8vo., Cloth. $3.

GAS COMPANIES DIRECTORY, 1891. $5.

THE AMERICAN GAS ENGINEER AND SUPERINTENDENT'S HANDBOOK, by WM. MOONEY. $3.

GAS ENGINE INDICATOR DIAGRAM, by W. E. AYRTON. Paper. 20 cents.

ILLUMINATING AND HEATING GAS, by W. BURNS. $1.50.

NOTES IN MECHANICAL ENGINEERING, by H. ADAMS. $1.

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS, by THOS. NEWBIGGING. Fifth edition. $6.

A TREATISE ON MASONRY CONSTRUCTION. BARKER. $5

FUEL AND ITS APPLICATIONS. $7.50.

ELECTRICITY.

THE ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage, and Distribution, by PHILIP ATKINSON. $1.50.

ELEMENTARY ELECTRICITY, by PROF. F. JENKIN. 40 cts

ELECTRIC TRANSMISSION OF ENERGY, by G. KNAPP. $3

ARC AND GLOW LAMPS, by J. MAIER. Illustrated. $3.

ELECTRICIAN'S POCKET-BOOK, by MONROE and JAMIESON. $2.50.

MAGNETISM AND ELECTRICITY, by J. OVEREND. 40 cents.

ACCUMULATORS, by SIR D. SALOMONS. $1.20.

DYNAMO BUILDING, by F. W. WALKER. 80 cents.

ELECTRICAL TABLES AND FORMULÆ, by L. CLARK and R. SABINE. $5.

ELECTRIC LIGHTING FROM CENTRAL STATIONS, by G. FORBES. Paper. 40 cents.

ELECTRIC LIGHT PRECAUTIONS, by K. HEDGES. Illustrated. $1.

SUPPLY OF ELECTRICITY BY LOCAL AUTHORITIES, by K. HEDGES. Paper. 40 cents.

DOMESTIC ELECTRICITY FOR AMATEURS, by E. HOSPITALIER. $3.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order.

A. M. CALLENDER & CO., 32 Pine Street, New York.

THE BERLIN IRON BRIDGE CO.,

Engineers, Architects & Bldrs. of Iron & Steel Buildings

CHAS. M. JARVIS, Pres. & Chief Engr.
BURR K. FIELD, Vice-President.
F. L. WILCOX, Treasurer.
GEO. H. SAGE, Secretary.

Office and Works, No. 6 Railroad Avenue, - - EAST BERLIN, CONN.

Send for our Illustrated Catalogue.

GASHOLDER PAINT.

Use Only

THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO., 104 High Street, Boston, Mass.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., No. 54 Pine St., N. Y.

THE NEW

HANDY BINDER.

This article may be described as elegant in appearance, strong, durable, and possessing many special qualities of its own. It allows the opening of the pages perfectly flat, whether one or several numbers are in the binder Any number can be taken out and replaced without disturbing he others. The papers are not mutilated for subsequent binding in permanent form. The binder is supplied with gilt side title, and is an ornament to any desk or reading table. The JOURNAL, filed in the Handy Binder, becomes a volume of great alue, always convenient for instant reference. **Handy Binder, Postage paid, $1.00.**

A. M. CALLENDER & CO., 32 PINE STREET, NEW YORK CITY.

Fuel and Its Applications

By E. J. MILLS, D.Sc. F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

7 PLATES, AND 607 OTHER ILLUSTRATIONS. ROYAL OCTAVO, PAGES XX, 802. HANDSOME CLOTH, $7.50.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

Newbigging's Handbook for Gas Engineers and Managers.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text, and much of it has been rewritten and otherwise improved. Price, cloth, $6.

A. M. CALLENDER & CO., 32 Pine St. N. Y.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

MANUFACTURERS OF

Standard 3 Diaphragm Dry Meter.

Gas Meters,

STATION METERS,

METER PROVERS, PHOTOMETERS,

Experimental Meters of all Kinds,

AND

Standard 2 Diaphragm Dry Meter.

Apparatus for Testing the Quantity and Quality of Gases.

GAS STOVES

OF ALL SIZES AND FOR ALL PURPOSES.

Catalogues showing New Designs will be sent upon application.

MANUFACTORIES,

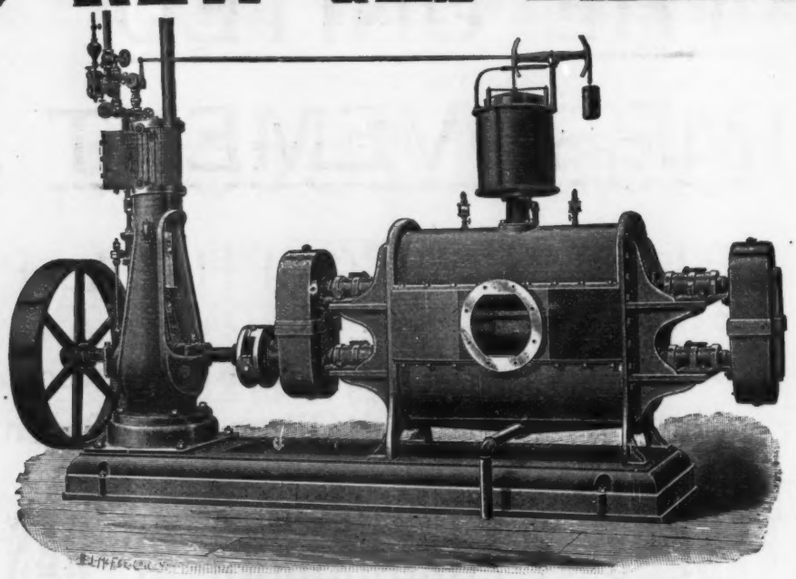
508 to 514 West Twenty-second St., N. Y. Arch and Twenty-second Sts., Phila. 125 & 127 S. Clinton St., Chicago.

AGENCIES,

No. 177 Elm Street, Cincinnati, Ohio. No. 222 Sutter Street San Francisco Cal.
No. 810 North Second Street, St. Louis, Mo.

GAS STOVE SHOW ROOMS, 242 Sixth Avenue, New York City.

ROOTS' NEW GAS EXHAUSTER.



UNSURPASSED FOR

Neatness of Design, Durability, Simplicity, Efficiency, and Economy of Power.

THE ONLY EXHAUSTER MADE WHERE

The Parts Needing Attention are External, and Easily Accessible.

THE P. H. & F. M. ROOTS CO., CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt., COOKE & CO., Selling Agts., 163 & 165 Washington St., N. Y.

THE WALKER TAR AND CARBONIC ACID EXTRACTOR.

A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the Tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, six years ago, in England, of the C. & W. Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. Several have been erected in the United States.

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers.

"C. A. GERDENIER, Supt. Bridgeport (Conn.) Gas Lt. Co."

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results guaranteed in every instance.

GEO. SHEPARD PAGE'S SONS, Sole Agts. for Western Hemisphere, 69 Wall St., N. Y.

Gasholder Tanks & Gas Works Masonry Complete.

PLANS PREPARED AND ESTIMATES FURNISHED AT SHORT NOTICE.

J. P. WHITTIER, 70 Rush St., near Division Av., Brooklyn, N. Y.

A Large Quantity of Ground Fire Brick For Sale Cheap.

1892 DIRECTORY 1892

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

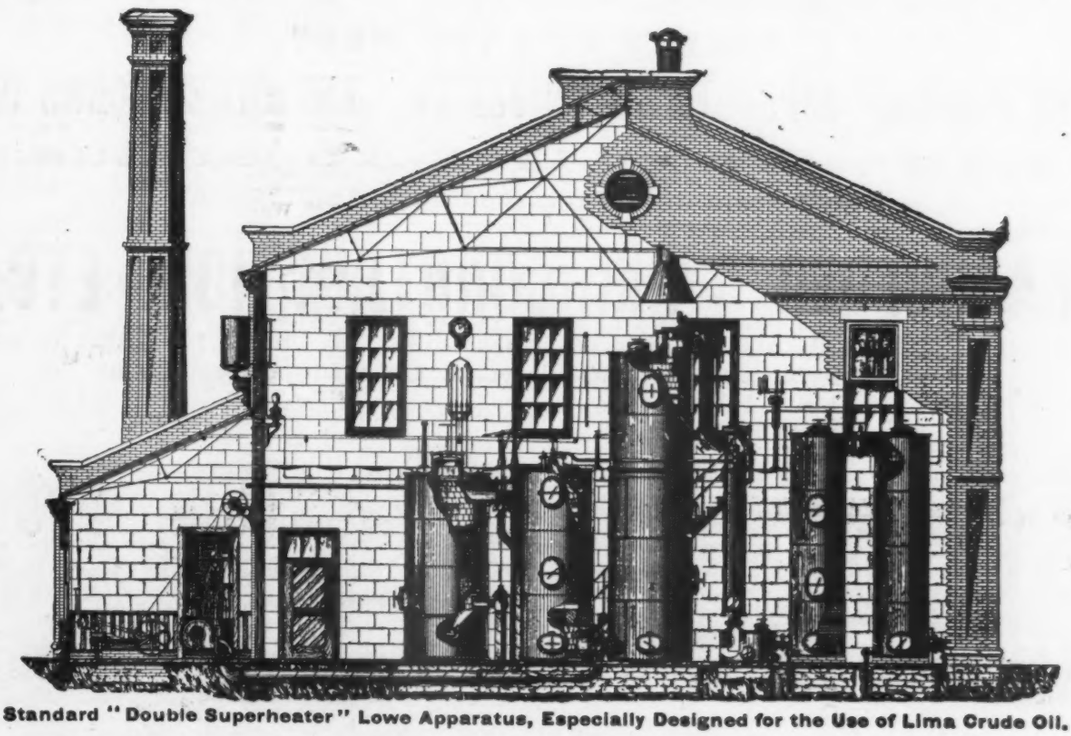
A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Owners of the Lowe, Granger-Collins, McKay-Critchlow (for carbureting Natural Gas), and Other Gas Patents.

BUILDERS, LESSEES and PURCHASERS OF GAS WORKS.



Standard "Double Superheater" Lowe Apparatus, Especially Designed for the Use of Lima Crude Oil.

Erectors of

WATER GAS PLANTS,

(Either Independent or Auxiliary to Coal Gas Works),

USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE

PAMPHLETS, PLANS, AND ESTIMATES FURNISHED UPON APPLICATION.

NATIONAL
GAS LIGHT AND FUEL CO.,

No. 52 Lake Street, Chicago.

FRED'K H. SHELTON, Manager.

GAS WORKS

Built, Remodeled, Leased, or Purchased.

Sole Builders OF THE Springer Cupola System,

Including Solid Arch, "Sliding" or "Bye-Pass" Combustion Valve Forms, and all Modern Improvements.

Also, by Special Arrangement with the United Gas Improvement Company,

AGENTS FOR THE WEST

FOR THE "DOUBLE-SUPERHEATER," "JUNIOR," AND OTHER FORMS OF THE

Lowe Water Gas Apparatus.

Full Information Furnished upon Application.

GASHOLDER TANK CONSTRUCTION, ETC.

Gas Companies and others about to erect Gasholders will find it profitable to consult W. C. Whyte, who for over 30 years has made a specialty of

Tank Excavation and Mason Work.

Fifty Tanks now in operation show the sort of work done. Address

W. C. WHYTE, - - - No. 15 Cortlandt Street, N. Y. City.

NATIONAL GAS AND WATER CO.,

218 La Salle St., Chicago, Ill.

C. D. HAUK, President. HENRY C REW, Vice-Pres't. N. A McCLARY, Secretary. IRWIN REW, Treasurer. E. E. MORRELL, Engineer.

BUILDERS AND OPERATORS OF

Gas Works and Water Works.

WATER GAS APPARATUS A SPECIALTY.

Guaranteed Estimates of Cost of Gas in Holder Furnished upon Application.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

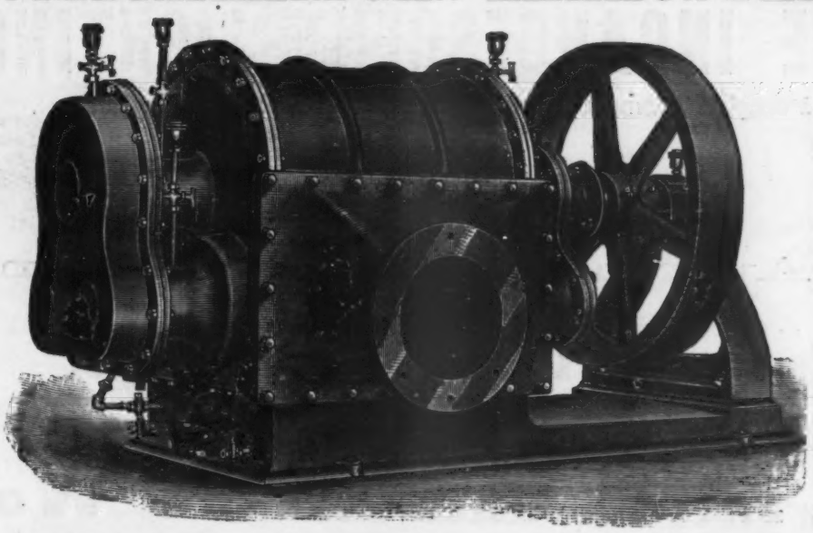
AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC COVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 351 Canal St., New York.

WILBRAHAM GAS EXHAUSTER



WILBRAHAM BROS.,

PHILADELPHIA, PA.

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y.

JARVIS ENGINEERING CO.,

61 Oliver St., Boston, Mass.

CONTRACTORS FOR ERECTING

COMPLETE STEAM OUTFITS FOR ELECTRIC LIGHTING STATIONS.

Steel Boilers set with Jarvis Pat. Boiler Setting

To burn **COKE SCREENINGS** for Fuel.

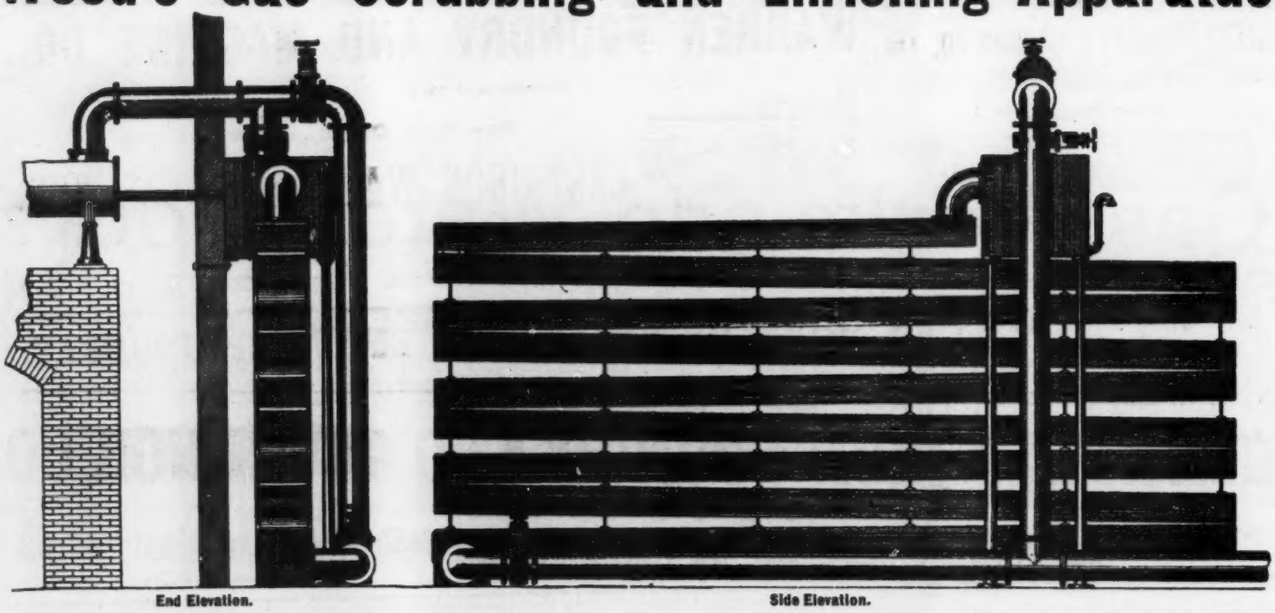
ARMINGTON & SIMS CO. ENGINES,

Belting direct to Dynamos, without using Shafting.

SEND FOR CIRCULARS.

REFERENCES.—Charlestown Gas & Electric Light Co., Charlestown, Mass.; Schenectady Gas & Electric Light Co., Schenectady N. Y.; Brookline Gas Co., Brookline, Mass.

Wood's Gas Scrubbing and Enriching Apparatus.



End Elevation. Side Elevation.

The cheapest, simplest, and most effective apparatus for removing Tar and Ammonia, and enriching Gas, ever brought to the attention of Gas Manufacturers. With ordinary condensers and scrubbers the condensable illuminants flow off to the tar wells and liquor tanks and are lost, but with Wood's Apparatus these illuminants are saved and retained in the gas, thus increasing its illuminating power and making a great saving in the cost of enriching material. Where set up next after the Hydraulic main, this Scrubber produces an 8-oz. Ammoniacal Liquor.

JAMES R. FLOYD & SONS, - - Nos. 531 to 543 West 20th Street, N. Y. City.

FORT WAYNE ELECTRIC CO.

FORT WAYNE, IND.

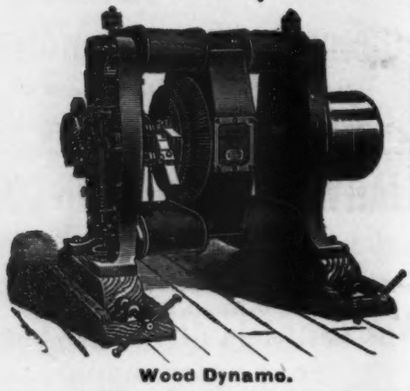
MANUFACTURERS OF THE

Slattery Induction System

—OF—

LONG DISTANCE INCANDESCENT LIGHTING.

The Most Carefully Worked Out and Complete Alternating Current System of Electric Lighting in Existence.



Wood Dynamo.

—AND THE—

WOOD

Automatically Regulating

ARC DYNAMOS AND LAMPS.

Main Office and Factory, Fort Wayne, Ind.

BRANCH OFFICES.

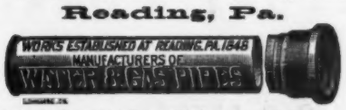
NEW YORK,	42 & 44 Broad Street.	PITTSBURGH, PA.,	533 Wood Street.
PHILADELPHIA,	907 Filbert Street.	DALLAS, TEXAS,	McLeod Building.
CHICAGO,	185 Dearborn Street.	TORONTO, CANADA,	138 King Street, West.
SAN.FRANCISCO	35 New Montgomery Street.	MEXICO, F Adams' Successors,	City of Mexico.
BUFFALO	228.Pearl Street.	CUBA, Maicas & CO.,	Havana.

ENGINEERS.

P. D. WANNER, Chairman. A. H. MELLERT, Mangr. of Wks.
R. B. KINSEY, Secretary. F. A. KNOPP, Treasurer.

MELLERT FOUNDRY & MACHINE CO. Ltd. and READING FOUNDRY CO., Ltd.

Reading, Pa.



Specials—Flange Pipe, Valves and Hydrants Lamp Posts, Retorts, etc.

General Foundry and Machine Work.

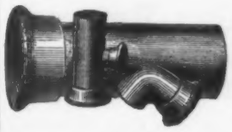
JOHN FOX, Selling Agent. **160 Broadway, N.Y.**

GAS AND WATER PIPES.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

GAS AND WATER PIPES.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

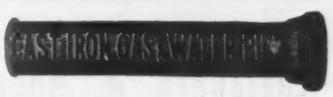
BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS.

Columbus, Ohio.

M. J. DRUMMOND,



SPECIAL CASTINGS AND LAMP POSTS.

Office, Corbin Building, 192 Broadway, N. Y.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, Pa.

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

THE ADDYSTON PIPE AND STEEL COMPANY.

CAST IRON **CINCINNATI, OHIO.**

PIPE FOR MANUFACTURED AND NATURAL GAS AND WATER.

SPECIALS, FLANGE PIPE, AND LAMP POSTS

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

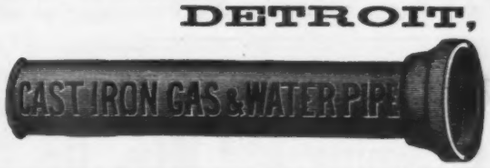
Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.

JAS. McMILLAN, Prest. HUGH McMILLAN, Vice-Prest. W. C. McMILLAN, Sec. & Treas. J. H. WHITING, Gen. Supt.

DETROIT PIPE & FOUNDRY CO.,

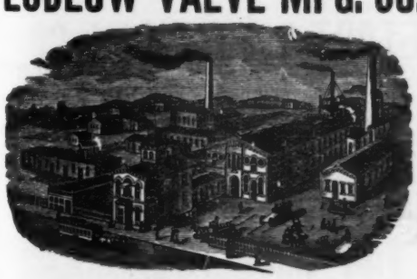
DETROIT, MICH.



Flange Pipe, Branches & Special Castings.

GENERAL FOUNDRY WORK.

LUDLOW VALVE MFG. CO.



OFFICE AND WORKS,
938 to 954 River Street and 67 to 83 Vail Av., TROY, N. Y.

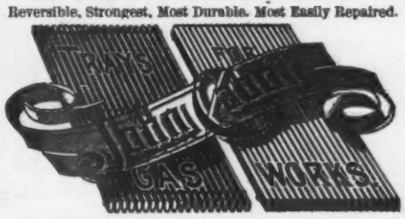
Hydraulic Main Lip Regulators, also Check Valves, Foot Valves, Yard-wash and Fire Hydrants.
Send for Circulars.

Valves.—Double and Single Gate, ¾ in. to 48 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, and Oil. Send for Circulars.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable. Most Easily Repaired.



306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.
Send for Circulars.

The Weston Standard

VOLTMETERS AND AMMETERS.

These Instruments are the most accurate, reliable, and sensitive portable instruments ever offered. A large variety of ranges, to meet the requirements of all kinds of work.
Send for Catalogue.

Weston Electrical Instrument Co.,

Office & Factory, 114-120 William St, Newark, N. J.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants With and Without Independent Nozzle Valve. All Work Guaranteed.

WORKS & GEN'L OFFICE:
Indian Orchard, Mass.

TREASURER'S OFFICE:
72 Kilby & 112 Milk Sts, Boston, Mass.

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

J. H. GAUTIER & COMPANY
CORNER OF
GREENE AND ESSEX STREETS,
JERSEY CITY, N. J.
MANUFACTURERS OF
Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,
H. GAUTIER, Prest. CHAS. E. GAUTIER, Sec. & Treas.
CHAS. E. GREGORY, V.-Prest. DAVID R. DALY Gen'l Mang'r.

BROOKLYN
Clay Retort & Fire Brick Works,
(EDWARD D. WHITE & CO.)
Manufacturers of Clay Retorts, Fire Brick, Gas House and other Tile.
VAN DYKE, ELIZABETH, RICHARDS & PARTITION STS.
Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE FIRE BRICK MFG. CO.,
MANUFACTURERS OF
Fire Brick, Gas Retorts,
AND
ST. LOUIS STANDARD SEWER PIPE.
Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.
OFFICE AND DEPOT
901, 903, and 905 Pine Street,
ST. LOUIS, MO.

ESTABLISHED IN 1845.
B. KREISCHER & SONS,
OFFICE FOOT OF HOUSTON ST., E.R., N.Y.
Gas Retorts,
TILES, FIRE BRICK.
AND EVERYTHING IN THE FIRE CLAY LINE.

MANHATTAN
FIRE BRICK & ENAMELLED CLAY
RETORT WORKS
ADAM WEBER.
CLAY GAS RETORTS
AND RETORT SETTINGS
FIRE BRICKS, TILES, ETC.,
Office and Works, 15th Street and Avenue C., N. Y

CYRUS BORGNER, Successor to
BORGNER & O'BRIEN
23d ST. ABOVE RACE PHILADA. PA. U.S.A.
FIRE BRICK AND CLAY RETORTS

Works, LOCKPORT STATION, PA.
—ESTABLISHED 1864.—
JAMES GARDNER, JR.,
Successor to WILLIAM GARDNER & SON.
Office, Rooms 19 & 20, Lewis Block PITTSBURGH, PA. P. O. Box 373
Fire Clay Goods for Gas Works.
SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.
H. A. NORTON, No. 92 WATER STREET, BOSTON, MASS., Agent for the New England States.

HENRY MAURER & SON,
(ESTABLISHED 1856.)
EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS
WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.
Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.
A Cement of great value for patching retorts, putting on mouthpieces making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.
PRICE LIST.
In Casks, 600 to 800 lbs., f.o.b. N. Y., at 5 cents per pound.
In Kegs, 100 to 300 lbs., " " at 6 " "
In Kegs less than 100 lbs., " " at 7 " "
C. L. GEROULD & CO.,
5 & 7 Skillman St., Brooklyn, N. Y.
Western Agent, H. T. GEROULD, Wichita, Kan.

Parker-Russell Mining and Mfg. Co.,
CITY OFFICE,
Mermod-Jaccard Bldg., Rooms 307 & 308, Broadway & Locust St., St. Louis, Mo.
PROPRIETORS OF THE
OAKHILL GAS RETORT & FIRE BRICK W'KS
Our immense establishment is now employed almost entirely in the manufacture of
Materials for Gas Companies
We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We have the *exclusive Agency for the West* of the celebrated
Kloenne-Bredel Full Depth and Semi-Recuperator Benches,
And also furnish and build
Our Own Styles Semi-Recuperator Furnaces for the use of Coal or Coke as fuel.

THOS. SMITH, Prest. AUGUST LAMBLA, Vice-Prest. & Supt.
BALTIMORE
RETORT & FIRE BRICK CO.
MANUFACTORY AT
LOCUST POINT BALTIMORE, MD.
Clay Retorts, Blocks & Tiles
FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.
Red and Buff Ornamental Tiles and Chimney Tops. Drain and Sewer Pipe (from 2 to 30 inches). Baker Oven Tiles 12x12x2 and 10x10x2.
WALDO BROS., 88 WATER ST., BOSTON, MASS
Sole Agents the New England States.

King's Treatise on Coal Gas. In Three Volumes. Price per Vol., $10. Sold either by Volume or in Sets.
A Standard text-book for the Engineers and Managers of Gas Works, and for all who are concerned or take an interest in the manufacture and distribution of Coal Gas, and in the utilization of the Secondary Products resulting therefrom; treating also of the Gas Engine and of Gas Cooking and Heating Appliances. A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

FRED. BREDEL, C. E.,

PROP'R OF KLOENNE AND BREDEL PATENTS.

Recuperative Furnaces, Purifying Machines,

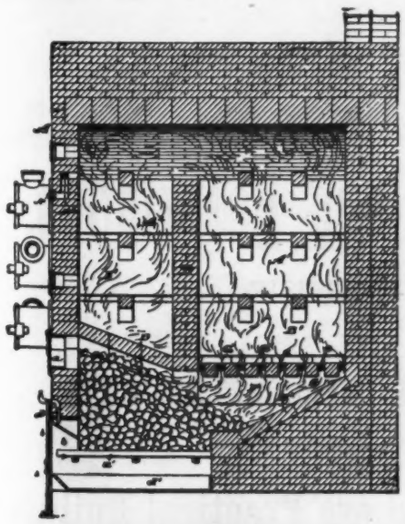
* Gas Apparatus. *

Main Office, 118 Farwell Avenue, Milwaukee, Wis.

New York Office, 22 Beaver Street.

FLEMMING'S

Generator-Gas Furnace



Materials furnished and Benches erected by

J. H. GAUTIER & CO., - Jersey City, N. J.

Address as above, or D. D. FLEMMING, Jersey City, N. J

AMERICAN GAS LIGHT JOURNAL

$3.00 per Annum.

A. M. CALLENDER & CO.,
29 Pine Street, N. Y

The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY.

Gas Companies and others intending to erect Lamps and Posts will do well to communicate with us.

The American Gas Engineer and Superintendent's Handbook.

By WM. MOONEY.

350 Pages, Full Gilt Morocco. Price, $5.00.

A. M. CALLLENDER & CO., 32 Pine St., N. Y.

DAVIS & FARNUM MFG. CO.,

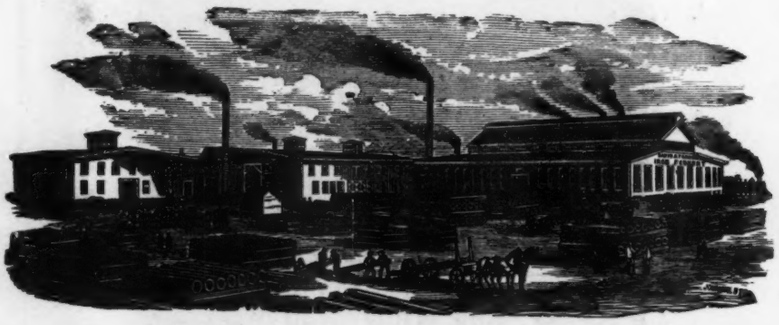
WALTHAM, MASS.

PRINCIPAL OFFICE AND WORKS, Waltham, Mass. BOSTON OFFICE, Room 18, Vulcan Building, 8 Oliver Street.

SINGLE, DOUBLE, AND TRIPLE LIFT

Gasholders.

OF ANY CAPACITY.



TUBULAR, PIPE, AND SINUOUS FRICTION

Condensers.

OF ALL SIZES.

IRON ROOF FRAMES AND FLOORS.

Purifying Boxes, Center Seal or Valve Connections, Bench Work.

Reversible Lime Trays.

SELF-SEALING AND PRESSED STEEL MOUTHPIECE LIDS.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Plant

—ALSO—

Gas and Water Pipe, Flanged Pipe,

Sugar House Work, and Special Castings of all Descriptions.

Established 1861. Incorporated 1881.

KERR MURRAY MFG. CO.,

FORT WAYNE, IND.

Those who are in need of

Holders or Gas Works Apparatus of any Description,

AND OF THE LATEST IMPROVEMENTS,

will find it to their interest to

GET AN ESTIMATE FROM US

before placing their order.

As we make a Specialty of this Class of Work, and are Practical Builders and Manufacturers of same,

with our long years of experience in the business,

WE CAN GUARANTEE YOU SATISFACTION.

Estimates, Plans and Specifications Furnished on Application.

BARTLETT, HAYWARD & CO.

Baltimore, Md.

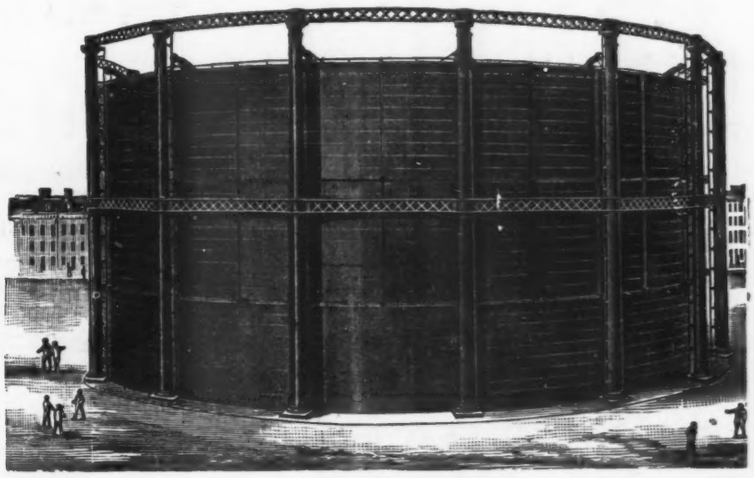
Triple Double, & Single-Lift
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Cirders.

BEAMS.



PURIFIERS.

CONDENSERS.

Scrubbers.

BENCH CASTINGS.

OIL STORAGE TANKS.

Boilers.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

Munich Regenerative Furnace, System Drs. Schilling & Bunte.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

Pascal Iron Works. ESTABLISHED —1821.— Delaware Iron Works.

MORRIS, TASKER & CO.,

INCORPORATED.

OFFICE, 224 SOUTH THIRD STREET, - - PHILADELPHIA, PA.

CONTRACTORS, BUILDERS, AND MANUFACTURERS OF

Gas, Water & Sugar Works

Bench Castings.

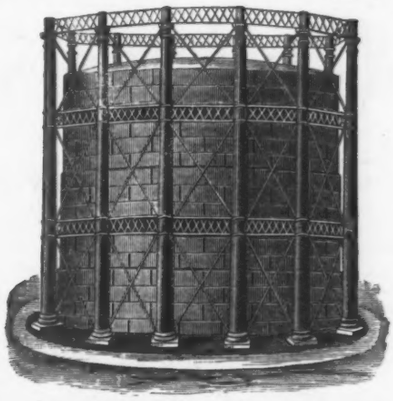
Condensers.

Scrubbers.

Purifiers.

Hyd. Carriages.

Iron Floors,



Iron Roofs.

Street Stops,

Valves, etc.

Stand-Pipes.

Water & Oil

Tanks, all Sizes.

Single, Double, and Triple-Lift Gas Holders.

SELF-SEALING RETORT LIDS. STAMPED STEEL RETORT LIDS.

Locomotive Water Columns, Filters, etc. Boiler Tubes, Wrought Iron Pipe & Fittings.

Plans, Specifications and Estimates for all kinds of Machinery furnished on application.

Foundries and Works: {Millville, N. J. Florence, " Camden, "

R. D. WOOD & CO.

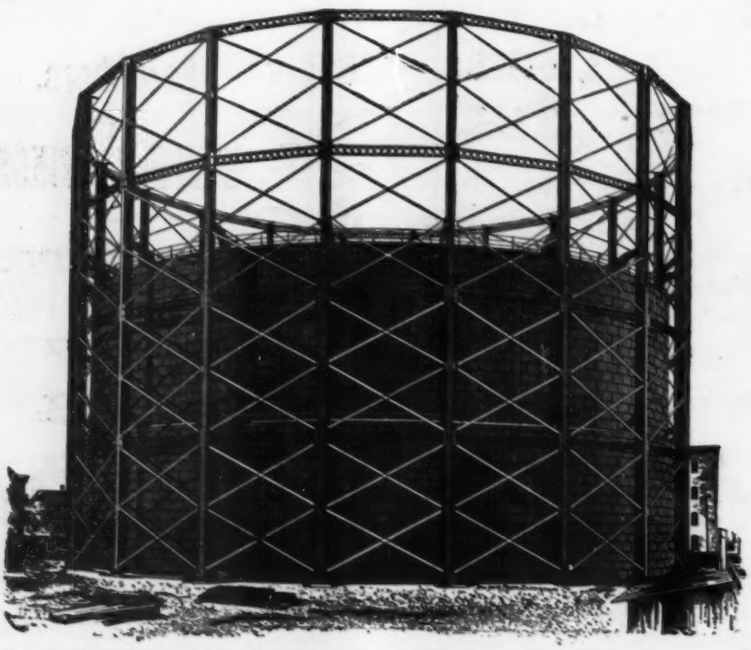
Engineers, Iron Founders, Machinists.

No. 400 Chestnut Street,

PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE.



GAS HOLDERS

SINGLE, DOUBLE & TRIPLE LIFTS,
WITH OR WITHOUT
WROUGHT IRON OR STEEL TANKS.

PURIFIERS. CONDENSERS. SCRUBBERS.

SOLE MAKERS OF

The Standard Mitchell Scrubbers.

(PATENTED)

THE HOPPER AUTOMATIC GAS GOVERNOR,
BENCH WORK,
PLATE GIRDERS, IRON FLOORS AND ROOFS,
THE TAYLOR REVOLVING-BOTTOM GAS-PRODUCER,
HEAVY LOAM CASTINGS.

HYDRAULIC WORK,
LAMP POSTS, VALVES, ETC.

ISBELL-PORTER COMPANY,

G. G. PORTER, Prest. (Successors to SMITH & SAYRE MFG. COMPANY) CHAS. W. ISBELL, Secy.

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

Special Castings, Tees, Bends, etc.
Bench Castings.
Water Gas Generators.
Hydraulic Mains.
Iron Floors.
Brenner Self-Sealing Retort Lids.
Tar Gates and Hydraulic Main Dip Regulators.
Hutchison's Tar Displacement Apparatus.
Multitubular Condensers.
Standard Washer-Scrubbers.
Tower Scrubbers.
Walker's Tar and Carbonic Acid Extractors.
Exhausters.
Engines.
Steam Jet Exhausters.
Exhauster Governors.
Compensators.
Self-Acting Bye-Pass Valves.
Valves.
Valve Stands with Indicators.
Purifying Boxes.
Purifier Valve System.
Center Seals.
Street Governors.

Estimates, Drawings and Specifications Furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

ISBELL-PORTER COMPANY,

No. 245 Broadway, New York City.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.

JAMES R. FLOYD & SONS,

(SUCCESSORS TO HERRING & FLOYD)

Oregon Iron Works,

W. 20th & 21st. Sts., bet. 10th & 11th Avs.,

NEW YORK CITY.

Engineers and Contractors

FOR THE

CONSTRUCTION OF GAS WORKS.

MANUFACTURERS OF

All Kinds of Castings and General Ironwork

FOR

GAS APPARATUS.

Bench Castings, Regenerative and Half Regenerative Furnace Castings.

Condensers, Scrubbers, Purifiers, Street Drips and Connections,

Valves,

Hydraulic Hoisting Purifier Carriage, Self-Sealing Retort Lids, Improved Valve Stand and Indicator, Seller's Cement.

Plans, Specifications, and Estimates furnished for Construction of New or Alteration of Old Works.

Bouton Foundry Co.,

FOUNDERS AND MACHINISTS,

CHICAGO, ILL.

Gas Works Apparatus,

PURIFIERS, CONDENSERS,

Bench Work

SPECIALS. LAMP POSTS,

SCRUBBERS,

Iron Roofs and Floors.

Plans and Estimates furnished for new works or extensions of old works.

H. RANSHAW, Prest. & Mangr. WM. STACEY, Vice-Prest. T. H. BIRCH, Asst. Mangr. R. J. TARVIN, Sec. & Treas.

STACEY MFG. CO.,

MANUFACTURERS OF

Single and Telescopic Gasholders,

IRON ROOFS, BRIDGES, LAMP POSTS,

Water and Oil Tanks, Coal Elevator Cars,

COKE CRUSHERS, BENCH CASTINGS,

And all kinds of Wrought and Cast Iron Work used in the erection of Coal and Oil Gas Works Rolling Mill Machinery and Heavy Castings a Specialty.

Foundry: 33, 35, 37 & 39 Mill Street.

Wrought Iron Works: 16, 18, 20, 22, 24 & 26 Ramsey Street.

Cincinnati, Ohio.

1842. # DEILY & FOWLER, 1892.

Laurel Iron Works.

Address, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

GASHOLDERS,

Single and Telescopic.

Holders Built 1885 to 1891, Inclusive

Chester, Pa.	Little Rock, Ark.	Northern Gas Lt. Co., of	Calais, Me.	Victoria, B. C.
Hazleton, Pa. (2d.)	Irvington, N. Y.	New York, N. Y.	New London, Conn. (2d)	Vancouver, B. C.
Staten Island, N. Y.	South Boston, Mass.	Willimantic, Conn	West Chester, N. Y.	Charlottesville, Va.
Saugerties, N. Y.	Rye, N. Y. (2)	Montclair, N. J.	Bay Shore, L. I.	So. Framingham, Mass.
Clinton, Mass. (Lan. Mills)	Woodstock, Ont.	Attleboro, Mass.	Washington, D. C.	Woonsocket, R.
Chattanooga, Tenn.	Malden, Mass.	Santa Cruz, Cal.	Newport, R. I. (2d)	Simcoe, Can.
Galveston, Texas. (3d.)	Staten Island, N. Y. (2d)	Erie, Pa. (2d)	Morristown, N. J.	Pittsfield, Mass. (2d)
Fort Plain, N. Y.	Woodstock, Ont.	West Chester, Pa. (2d	Lebanon, Pa.	Chattanooga, Tenn. (2d)
Brunswick, Ga.	Malden, Mass.	Lancaster, Pa. (3d	Oakland, Cal.	So. Bethlehem, Pa. (2d)
Port Chester, N. Y.	Paducah, Ky.	Tacony, Pa. (two)	Central Gas Lt. Co., New York City (2d)	"Vassar College," N. Y
New Rochelle, N. Y.	Norwich, Conn.	Mount Vernon, N. Y		So. Chester, Pa.
Salem, N. J. (3d)	Seattle, W. T.	Binghamton, N. Y.	Tacoma, Wash.	Cumberland, Md.
Omaha, Neb. (2d)	San Diego, Cal.	Concord, N. H.	Knoxville, Tenn.	Auburn, N. Y.
Lynn, Mass. (3d)	Westerly, R. I.	Dover, Del. (2d)	Pottstown, Pa.	DesMoines, Ia.

ILLUMINATING GAS! FUEL GAS!

The Loomis Process.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Sons' Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

WM. HENRY WHITE,

No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.

Plans and Estimates Furnished

Foundries and Works: { Millville, N. J. / Florence, " / Camden, " }

R. D. WOOD & CO.

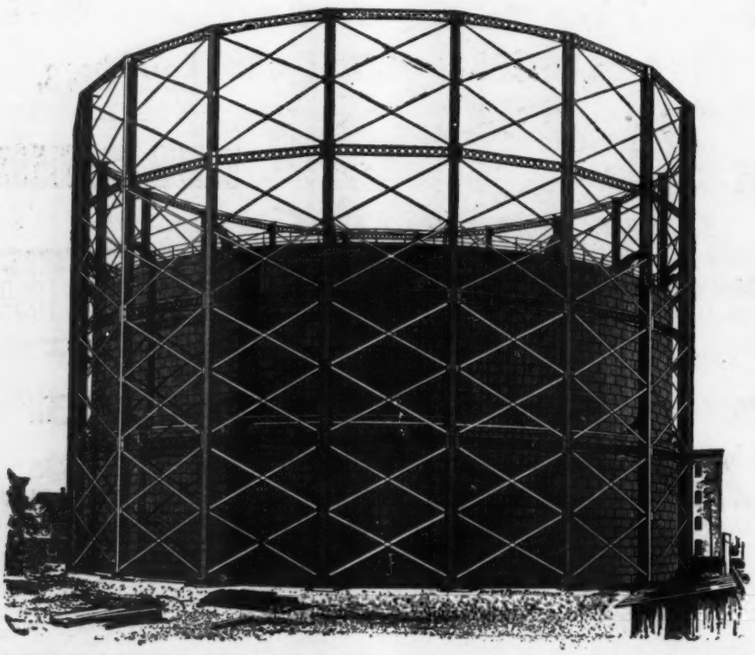
Engineers, Iron Founders, Machinists.

No. 400 Chestnut Street,

PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE.



GAS HOLDERS

SINGLE, DOUBLE AND TRIPLE LIFTS,
WITH OR WITHOUT
WROUGHT IRON OR STEEL TANKS.

PURIFIERS. CONDENSERS. SCRUBBERS.

SOLE MAKERS OF

The Standard Mitchell Scrubbers.

(PATENTED)

THE HOPPER AUTOMATIC GAS GOVERNOR,
BENCH WORK,
PLATE GIRDERS, IRON FLOORS AND ROOFS,
THE TAYLOR REVOLVING-BOTTOM GAS-PRODUCER,
HEAVY LOAM CASTINGS.

HYDRAULIC WORK,
LAMP POSTS, VALVES, ETC.

ISBELL-PORTER COMPANY,

G. G. PORTER, Prest. (Successors to SMITH & SAYRE MFG. COMPANY) CHAS. W. ISBELL, Secy.

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

Special Castings, Tees, Bends, etc.
Bench Castings.
Water Gas Generators.
Hydraulic Mains.
Iron Floors.
Brenner Self-Sealing Retort Lids.
Tar Gates and Hydraulic Main Dip Regulators.
Hutchison's Tar Displacement Apparatus.
Multitubular Condensers.
Standard Washer-Scrubbers.
Tower Scrubbers.
Walker's Tar and Carbonic Acid Extractors.
Exhausters.
Engines.
Steam Jet Exhausters.
Exhauster Governors.
Compensators.
Self-Acting Bye-Pass Valves.
Valves.
Valve Stands with Indicators.
Purifying Boxes.
Purifier Valve System.
Center Seals.
Street Governors.

Estimates, Drawings and Specifications Furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

ISBELL-PORTER COMPANY,

No. 245 Broadway, New York City.

GAS WORKS APPARATUS AND CONSTRUCTION. GAS WORKS APPARATUS AND CONSTRUCTION.

JAMES R. FLOYD & SONS,
(SUCCESSORS TO HERRING & FLOYD)
Oregon Iron Works,
W. 20th & 21st. Sts., bet. 10th & 11th Avs.,
NEW YORK CITY.
Engineers and Contractors
FOR THE
CONSTRUCTION OF GAS WORKS.
MANUFACTURERS OF
All Kinds of Castings and General Ironwork
FOR
GAS APPARATUS.
Bench Castings, Regenerative and Half Regenerative Furnace Castings.
Condensers, Scrubbers, Purifiers, Street Drips and Connections,
Valves,
Hydraulic Hoisting Purifier Carriage, Self-Sealing Retort Lids, Improved Valve Stand and Indicator, Seller's Cement.
Plans, Specifications, and Estimates furnished for Construction of New or Alteration of Old Works.

Bouton Foundry Co.,
FOUNDERS AND MACHINISTS,
CHICAGO, ILL.
Gas Works Apparatus,
PURIFIERS, CONDENSERS,
Bench Work
SPECIALS. LAMP POSTS,
SCRUBBERS,
Iron Roofs and Floors.
Plans and Estimates furnished for new works or extensions of old works.

H. RANSHAW, Prest. & Mangr. WM. STACEY, Vice-Prest. T. H. BIRCH, Asst. Mangr. R. J. TARVIN, Sec. & Treas.
STACEY MFG. CO.,
MANUFACTURERS OF
Single and Telescopic Gasholders,
IRON ROOFS, BRIDGES, LAMP POSTS,
Water and Oil Tanks, Coal Elevator Cars,
COKE CRUSHERS, BENCH CASTINGS,
And all kinds of Wrought and Cast Iron Work used in the erection of Coal and Oil Gas Works. Rolling Mill Machinery and Heavy Castings a Specialty.
Foundry: 33, 35, 37 & 39 Mill Street. Wrought Iron Works: 16, 18, 20, 22, 24 & 26 Ramsey Street.
Cincinnati, Ohio.

1842. DEILY & FOWLER, 1892.
Laurel Iron Works.
Address, No. 39 Laurel Street, Philadelphia, Pa.
BUILDERS OF
GASHOLDERS,
Single and Telescopic.
Holders Built 1885 to 1891, Inclusive

Chester, Pa.	Little Rock, Ark.	Northern Gas Lt. Co., of New York, N. Y.	Calais, Me.	Victoria, B. C.
Hazleton, Pa. (2d.)	Irvington, N. Y.	Willimantic, Conn	New London, Conn. (2d)	Vancouver, B. C.
Staten Island, N. Y.	South Boston, Mass.	Montclair, N. J.	West Chester, N. Y.	Charlottesville, Va.
Saugerties, N. Y.	Rye, N. Y. (2)	Attleboro, Mass.	Bay Shore, L. I.	So. Framingham, Mass.
Clinton, Mass. (Lan. Mills)	Woodstock, Ont.	Santa Cruz, Cal.	Washington, D. C.	Woonsocket, R.
Chattanooga, Tenn.	Malden, Mass.	Erie, Pa. (2d)	Newport, R. I. (3d)	Simcoe, Can.
Galveston, Texas. (3d.)	Staten Island, N. Y. (2d)	West Chester, Pa. (2d	Morristown, N. J.	Pittsfield, Mass. (2d)
Fort Plain, N. Y.	Woodstock, Ont.	Lancaster, Pa. (3d	Lebanon, Pa.	Chattanooga, Tenn. (2d)
Brunswick, Ga.	Malden, Mass.	Tacony, Pa. (two)	Oakland, Cal.	So. Bethlehem, Pa. (2d)
Port Chester, N. Y.	Paducah, Ky.	Mount Vernon, N. Y	Central Gas Lt. Co., New York City (2d)	"Vassar College," N. Y
New Rochelle, N. Y.	Norwich, Conn.	Binghamton, N. Y.	Tacoma, Wash.	So. Chester, Pa.
Salem, N. J. (3d)	Seattle, W. T.	Concord, N. H.	Knoxville, Tenn.	Cumberland, Md.
Omaha, Neb. (3d)	San Diego, Cal.	Dover, Del. (2d)	Pottstown, Pa.	Auburn, N. Y.
Lynn, Mass. (2d)	Westerly, R. I.			DesMoines, Ia.

ILLUMINATING GAS! FUEL GAS!
The Loomis Process.
Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Sons' Saw Works, Tacony, Pa.
The Cheapest Gas Generating System in the World.
Plans and Estimates Furnished.
BURDETT LOOMIS, - - Hartford, Conn.

WM. HENRY WHITE,
No. 32 Pine Street, - - - New York City.
ENGINEER AND CONTRACTOR FOR THE
ERECTION AND EXTENSION OF
GAS, WATER, AND ELECTRIC LIGHT WORKS.
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished

GAS COALS. CANNEL COALS. COKE CRUSHERS.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 & 229 Produce Exchange, New York.

Cable Address, "PERKINS, NEW YORK." Post Office Box 3695, New York.

GENERAL SALES AGENTS FOR

The Youghiogheny River Coal Company's

OCEAN MINE YOUGHIOGHENY GAS COAL.

HON. W. L. SCOTT, Prest. M. H. TAYLOR, Vice-Prest.

This Colliery is located at SCOTT HAVEN, PA., in the center of the Youghiogheny Gas Coal District, and produces the ONLY RELIABLE YOUGHIOGHENY COAL for gas purposes. (See Map on p. 87 of this JOURNAL, Feb. 16, '85.)

POINTS OF SHIPMENT,

Locust Point, BALTIMORE. Pier No. 62, PHILADELPHIA.

ST. GEORGE, STATEN ISLAND, N. Y. HARBOR.

Also, Shippers of the following well-known Cannels:

Breckenridge & Old Kentucky Boghead from Kentucky,

AND THE

JELLICO CANNEL, from TENNESSEE.

Within the past four years we have delivered these Cannels to over One Hundred and Fifty Gas Companies in Thirty-five different States, and to some of the largest Gas Companies in

GREAT BRITAIN, ON THE CONTINENT, AND SOUTH AMERICA.

Single carloads or more delivered at any required point in the United States and Canada. Cargo shipments from

NEW YORK, PHILADELPHIA, BALTIMORE, NORFOLK, AND NEWPORT NEWS.

Particulars as to prices, etc., furnished upon application to the above address.

JAMES & WILLIAM WOOD,

Gas and Cannel Coal Contractors,

No. 40 St. Enoch Sq., Glasgow. No. 2 Talbot Court, London.

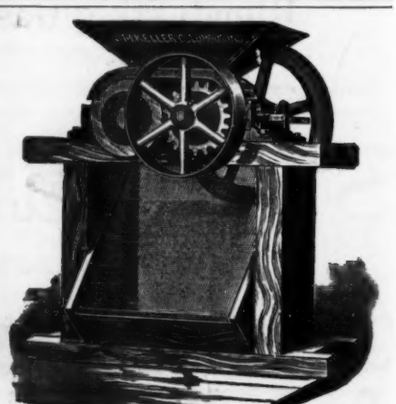
Proprietors of the **BATHVILLE COLLIERIES** (which produce the celebrated **BOGHEAD CANNEL**), Shields, Shieldmuir, Drumpeller, and other Collieries. This Firm offer

STANDARD CANNELS,

Unequaled as Gas Enrichers.

Analyses, prices, and all further information furnished on application to

Agency for U.S., Room 70, Nos. 2 & 4 Stone St., N.Y. City.



Keller's Adjustable Coke Crusher

SIMPLE, STRONG, AND DURABLE.

C. M. Keller, Sec. & Supt. Gas Lt. & Coke Co. Columbus, Ind.

Correspondence Solicited.

GAS ENRICHERS. GAS COALS. GAS COALS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, Clarksburg, Harrison Co., W. Va.
WHARVES, Locust Point, Baltimore, Md.
OFFICE, 44 South Street, Baltimore, Md

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS. } BANGS & HORTON, 60 Congress St., Boston.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City.

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor.

PLANS, SPECIFICATIONS, AND ESTIMATES FURNISHED.

Contracts taken for all Appliances required at a Gas Works,

Either for New Works or Extensions to Old Plants.

H. C. SLANEY,

Gas Engineer

446 E. 116th Street, New York.

Plans, Specifications and Estimates furnished for New Works, Alteration or Extension of Old Plants.

JAMES R. SMEDBERG,

Gas Engineer,

213 Jefferson Ave., Peoria, Ill.,

Will furnish Plans, Specifications and Estimates for the Remodeling or extension of Gas Works. Also, Analytic Reports upon the business condition and prospects of Gas Companies. Ample references will be given.

The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 92 PINE ST., N. Y. CITY.

THE

PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened & Prepared for Gas Purposes.

Their Property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

209 SOUTH THIRD STREET, PHILA., PA.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River; Pier No. 1 (Lower Side), South Amboy, N. J.

Chesapeake & Ohio Railway Coal Agency,

FOR THE SALE OF THE

Superior Kanawha Gas Coals, Cannelton Cannel,

Also, SPLINT AND STEAM COALS,

From the Kanawha and New River Regions, on the line of the Chesapeake & Ohio R'way.

C. B. ORCUTT, General Agent, - - No. 1 Broadway (Room 217) New York City

EDMUND H. MCCULLOUGH, Prest CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Penn.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.

JOHN J. GRIFFIN & CO.,

Nos. 1513, 1515, 1517 & 1519 Race Street, PHILADELPHIA.
No. 52 Dey Street, NEW YORK. No. 75 North Clinton Street, CHICAGO.

MANUFACTURERS OF

METERS FOR MEASURING GAS

IN ANY VOLUME.

Provers, Gauges, Registers, Etc., Etc.

EXPERIMENTAL APPARATUS FOR QUANTITATIVE AND QUALITATIVE ANALYSIS.

Careful and Prompt Attention paid to Repairing of all kinds of Meters and Apparatus.

Estimates Cheerfully Furnished.

Dry Gas Meters.

With 40 years' experience and the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

No. 153 Franklin Street, Boston, Mass.,

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges, Pressure and Vacuum Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Patent Cluster Lanterns for Street Illumination.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 122 & 124 Michigan St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

A. HARRIS. E. L. HARRIS. J. A. HARRIS.

Established 1848.

HARRIS BROS. & CO.,

Twelfth and Brown Streets, Phila., Pa. Agency, 67 & 69 S. Canal Street, Chicago.

S. S. STRATTON, Manager, Chicago.

Manufacturers of Wet and Dry Gas Meters,

STATION METERS, METER PROVERS,

EXPERIMENTAL METERS, SHOW OR GLAZED METERS,

Pressure and Vacuum Registers, Gauges, Photometers, Drip and Bell Pumps, Etc., Etc.

PROMPT ATTENTION GIVEN TO ALL ORDERS. METERS THOROUGHLY REPAIRED. ESTIMATES FURNISHED FOR STATION METERS OF ALL SIZES. CORRESPONDENCE SOLICITED.

GAS METERS. GAS METERS. GAS METERS.

GEO. J. McGOURKEY, Prest. WM. H. McFADDEN, Vice-Prest. (Phila.) WM. N. MILSTED, Gen. Supt. and Treas. (New York). WM. H. DOWN, Sec.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y
Arch & 22d Sts, Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
177 Elm Street, Cincinnati.
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

(Established 1848.)

GAS METER MANUFACTURERS,

Nos. 1339 to 1349 Cherry Street, Philadelphia, Pa.,

WET AND DRY GAS METERS, STATION METERS, EXPERIMENTAL METERS, METER PROVERS,

Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works.

FOULIS' PATENT STATION AND DISTRICT GOVERNORS.

REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of **all makers.**

D. McDONALD & CO.,

Established 1854.

154 West 27th Street, NEW YORK CITY.
51, 53 & 55 Lancaster St., ALBANY, N. Y.
34 & 36 W. Monroe St., CHICAGO, ILL.

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

KEYSTONE METER CO.
ROYERSFORD, PA.

CHAS. V. NEWMAN, Western Mangr.,
1434-1435 Unity Bldg., Chicago, Ills.

DRY GAS METERS.
STATION METERS.
METER PROVERS.
REPAIRING.

SPECIAL.—Having purchased the sole right to manufacture and sell meters with the HEARNE IMPROVED VALVE, in the U. S., we respectfully solicit orders for the same.

The superior feature of this meter is that it avoids the danger of displacement of the valves, and consequent loss of gas, either in shipping, handling, or by dishonest consumers.

To designate from the regular Glover Meter, also made by us, we style the above the HEARNE-GLOVER Meter.

It is worth your consideration.

Full descriptive circular sent on application.

W. WALLACE GOODWIN, President. E. STEIN, Vice-President. WM. E. STEEN, Sec. & Treas. H. B. GOODWIN, Superintendent.

THE GOODWIN GAS STOVE AND METER COMPANY,

1012, 1014 & 1016 Filbert Street, Philadelphia, Pa.

113 Chambers St., N. Y. 44 & 46 Dearborn St., Chicago. Agts., Waldo Bros., 88 Water St., Boston.

SOLE MANUFACTURERS OF THE

"Sun Dial" Gas Stoves,

IN A GREAT VARIETY OF STYLES AND SIZES.

Gas Cooking Stove No. 7 C.

The Most Economical, Efficient, and Durable Gas Stove Made.

SIZE.

Stove.	*Oven.*	*Broiler.*	*Top.*
31 inches high.	9¼ inches high.	10 inches high.	21 inches high.
17 inches wide.	15 inches wide.	15 inches wide.	16 inches wide.
	12¼ inches deep.	12¼ inches deep.	
	Length over extension shelves, 32 inches.		

This Stove has three Boiling Burners in the Top or Hot Plate, and single Oven Burner.

The consumption of this Stove is 35 cubic feet per hour, at 1¼ inch pressure with all burners.

Three-eighth inch supply pipe should be used when the pressure is 1¼ inches or over.

ALL FITTINGS ARE NICKEL PLATED.

Catalogue showing Styles and Prices sent free on application.

DRY and WET GAS METERS

Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc.

METER PROVERS (Sizes 2, 5 and 10 feet.)

Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6 and 9 in.), King's Pressure & Vacuum Gauges.

DRY & WET CENTER SEALS, DRY & WET GOVERNORS, EXHAUSTER GOVERNORS.

Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus Complete.

Also, TESTING AND CHEMICAL APPARATUS OF ALL KINDS, AND OF THE MOST PERFECT DESCRIPTION, FOR ALL PURPOSES RELATING TO GAS.

GOODWIN'S IMPROVED LOWE'S JET PHOTOMETER.

Agents for Bray's Patent Gas Burners and Lanterns.

Special attention to Repairs of Meters and all Apparatus connected with the business. All work guaranteed first-class in every particular. Orders filled promptly.